SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 19, 1909

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

RECENT PROGRESS IN AERONAUTICS[1]

THERE are two general classes of vehicles of the air, (*a*) those which depend for their support upon the buoyancy of some gas lighter than air, and (*b*) those which depend for such support upon the dynamic reaction of the air itself. These classes are designated:

(*a*) Lighter-than-air types:
Free balloons, dirigible balloons or airships.
(*b*) Heavier-than-air types:
Aeroplanes, orthopters, helicopters, etc.

It should be remarked, however, that these two general classes exhibit a growing tendency to overlap each other. For example, the latest dirigible balloons are partly operated by means of aeroplane surfaces, and are also often balanced so as to be slightly heavier than the air in which they move, employing the propeller thrust and rudder surfaces to control the altitude.

I. AEROSTATION

Captive and free balloons, with the necessary apparatus and devices for operating the same, have been for many years considered an essential part of the military establishment of every first-class power. They played a conspicuous part in the siege of Paris, and were often valuable in our own civil war. The construction and operation of aerostats are too well understood to need further attention here.

Although many aerodynamic data are needed for the proper design of a dirigible

[1] Abstract of an address before Section D—Mechanical Science and Engineering—American Association for the Advancement of Science, Baltimore, 1908.

airship, yet the experience already available in the construction and performance of such ships built on different plans is sufficient to enable the engineer to proceed with the design of a dirigible balloon to accomplish definite results along fairly accurate lines. In the case of this class of lighter-than-air ships the following general equation obtains:

$$W - w = V(\sigma - \sigma/n)$$

where

W = weight of balloon, envelope, car and aeronauts,
V = volume of balloon,
σ = density of the air,
n = density of air as compared with gas,
w = weight of air displaced by car and aeronauts and envelope of balloon.

If we call the weight of the gas in the balloon M, then we can write this equation in the following manner:

$$W + M = w + nM,$$

from which we find that

$$M = (W - w/n - 1)$$

and

$$V = [(W - w)/\sigma]\ [n/(n - 1)],$$

thus obtaining the volume of gas required. If the volume of the gas-bag, car, aeronauts, etc. $= v$, then $w = v\sigma$; so that the preceding equation may be written

$$V = [(W - v\sigma)/\sigma]\ [n/(n - 1)].$$

Thus far, certainly, no dirigible balloon has ever been developed which has attained an independent speed greater than forty miles per hour. It will readily be admitted that an airship so designed as to reach a speed of fifty or sixty miles per hour would be regarded as a most decided step forward in the art, since this difference of velocity is just the increment needed to place such craft on a practical basis capable of maneuvering in the air in all ordinary weather. This advancement, although requiring much consideration, would fully compensate in practical results.

The first point to be decided upon in the design of an airship is the method of maintaining the shape of the gas-bag against the pressure encountered at the maximum velocity to be attained. There are two schools of design in this respect, each having its adherents. One maintains the shape of the gas-bag by a rigid interior frame, and the other by means of the internal pressure of the gas itself.

Upon the selection of the type depends to a large extent the particular shape of the envelope. If the envelope is to maintain its shape by interior pressure of gas, evidently it must be so designed that the maximum pressure of the air developed at the speed contemplated shall not be sufficient to cause deformation of any part of the envelope. This can be effected only by making the uniform internal pressure at least equal to the maximum external pressure. Since the maximum external pressure occurs over the prow of the airship, this, evidently, is the particular part which must receive most careful attention with this system.

The desirable shape of head would evidently be one where the distribution of external pressure due to air resistance at the velocity used is uniform. In addition to preventing deformation of the gas-bag, a prime requisite also is that the shape shall be such that the total resistance, comprising head resistance and skin-friction, shall be a minimum for a given displacement and velocity.

This immediately forces the question of the law of resistance of the air. On this subject there are numerous aerodynamic data for low velocities, and also for very high velocities, but such data are incomplete for the range of velocities here considered.

In fact, the law of resistance of the air

for surfaces of revolution as experimentally determined, is known to vary not with any constant power of the velocity, but by a range of exponents from the first to the cube, if not higher. For example, in the enormous velocities attained by modern artillery, where bodies weighing a ton or more are hurled through the air at 2,000 feet per second, it is known that the physical phenomena become entirely different in nature from those found when dealing with moderate velocities such as are met in transportation devices.

If the rigid system be employed where an internal frame prevents deformation of the envelope, the stresses due to external pressure are taken up by the framework itself, and the gas required for flotation is usually contained in several separate receptacles or ballonets similar to compartments employed in ships. In this system, therefore, we are concerned only in securing such a shape of the rigid frame as will fulfill the condition of minimum total resistance for a given displacement and velocity.

Once the shape of the bag is determined from the considerations already enumerated, the dimensions become immediately fixed when the tonnage is assumed, or conversely, if any linear dimension is assigned the tonnage is thereby determined.

In addition to the two general systems above considered, there are various types involving some of the principles of each, which are classed in general as semi-rigid systems. Such systems usually comprise a rigid frame, to which is attached the gas-bag above, and the load below.

The next step is one of structural design along strictly engineering lines. The aerodynamic features of airship construction may be considered under the heads: (*a*) static balance, (*b*) dynamic balance, (*c*) stability, (*d*) natural period and oscillation.

Static Balance.—The dimensions of the gas-bag being determined, the lift of each transverse segment thereof is immediately known, and the design of the frame may proceed by approximate trial and correction as in other structural work. The weight of each segment of the envelope itself is readily computed, which, added to the corresponding segment of the frame, gives the total weight of each segment, and this total subtracted from the lift of each segment gives the net lift for that complete segment. From the magnitude and position of these net forces the position of the resultant lift is known, and this determines the vertical line through the center of gravity. Such procedure evidently insures static balance of the machine as a whole, and an approximate distribution of the load.

Dynamic Balance.—The dynamic balance must also be carefully considered; and here a difficulty has been experienced on account of the inability to place the resultant thrust coincident with the line of resistance of the ship as a whole. Heretofore, it has been customary to balance the thrust-resistance couple by means of suitable horizontal rudders or planes, so situated and at such angles that the resultant moment of the system should be zero at uniform speeds of travel, though not necessarily zero for accelerated motion.

If, however, the line of thrust be made coincident with the line of resistance, the disturbing moment in question will be eliminated at uniform speeds. If, furthermore, the center of mass be located on the line of thrust and sufficiently forward to form a righting couple with the resistance when the wind suddenly veers, the evil effects of a disturbing moment will be obviated for variable as well as for constant speeds. The ship is then dynamically balanced.

This, of course, requires that the form of hull be such that a quartering wind shall exert a force passing to the rear of the

center of mass. To illustrate, a good example of dynamic balance is found in a submarine torpedo, or a fish.

Stability.—The foregoing adjustments still allow the center of mass to be placed below the center of buoyancy. This is a provision that is important in aeronautics as well as in marine architecture; indeed, it is the only practical provision for keeping an even keel and preventing heeling when the ship is at rest, or simply drifting with the wind. If the center of gravity be well below the center of buoyancy, the vessel is proportionately stable, but, of course, the stability is pendular, and may admit of considerable rolling and pitching due to shifting loads, sudden gusts of wind, etc., unless special devices be used to dampen or prevent these effects.

Natural Period and Oscillations.—It may happen also that the equilibrium of the ship is disturbed by periodic forces whose periods are simply related to the natural period of the ship itself. In this case the oscillations will be cumulative and may become very large. Such effects are well known to marine engineers, and may be treated as in ordinary ship design.

II. AVIATION

This division comprises all those forms of heavier-than-air flying-machines which depend for their support upon the dynamic reaction of the atmosphere. There are several subdivisions of this class dependent upon the particular principle of operation. Among these may be mentioned the aeroplane, orthopter, helicopter, etc. The only one of these that has been sufficiently developed at present to carry a man in practical flight is the aeroplane. There have been a large number of types of aeroplanes tested with more or less success and of these the following are selected for illustration.

The design of an aeroplane may be considered under the heads of support, resistance and propulsion, stability and control.

Support.—In this class of flying-machines, since the buoyancy is practically insignificant, support must be obtained from the dynamic reaction of the atmosphere itself. In its simplest form, an aeroplane may be considered as a single plane surface moving through the air. The law of pressure on such a surface has been determined and may be expressed as follows:

$$P = 2k\sigma A V^2 \sin \alpha,$$

in which P is the normal pressure upon the plane, k is a constant of figure, σ the density of the air, A is the area of the plane, V the relative velocity of translation of the plane through the air, and α the angle of flight.

This is the form taken by Duchemin's formula for small angles of flight such as are usually employed in practise. The equation shows that the upward pressure on the plane varies directly with the area of the plane, with the sine of the angle of flight, with the density of the air, and also with the square of the velocity of translation.

It is evident that the total upward pressure developed must be at least equal to the weight of the plane and its load, in order to support the system. If P is greater than the weight the machine will ascend, if less, it will descend.

The constant k depends only upon the shape and aspect of the plane, and should be determined by experiment. For example, with a plane 1 foot square $k\sigma = 0.00167$, as determined by Langley, when P is expressed in pounds per square foot, and V in feet per second.

The first equation may be written

$$AV^2 = P/2k\sigma \sin \alpha.$$

If P and α are kept constant then the equation has the form

$$AV^2 = \text{constant}.$$

An interpretation of the second equation reveals interesting relations. The supporting area varies inversely as the square of the velocity. For example, in the Wright aeroplane, the supporting area at 40 miles per hour is 500 square feet, while if the speed is increased to 60 miles per hour this area need be only $500/1.52 = 222$ square feet, or less than one half of its present size. At 80 miles per hour the area would be reduced to 125 square feet, and at 100 miles per hour only 80 square feet of supporting area is required. These relations are conveniently exhibited graphically.

It thus appears that if the angle of flight be kept constant in the Wright aeroplane, while the speed is increased to one hundred miles per hour, we may picture a machine which has a total supporting area of 80 square feet, or a double surface each measuring about $2\frac{1}{2}$ by 16 feet, or 4 by 10 feet if preferred. Furthermore, the discarded mass of the 420 square feet of the original supporting surface may be added to the weight of the motor and propellers in the design of a reduced aeroplane, since in this discussion the total mass is assumed constant at 1,000 pounds.

In the case of a bird's flight, its wing surface is "reefed" as its velocity is increased, which instinctive action serves to reduce its head resistance and skin-frictional area, and the consequent power required for a particular speed.

Determination of k for Arched Surfaces.—Since arched surfaces are now commonly used in aeroplane construction, and as the first equation applies to plane surfaces only, it is important to determine experimentally the value of the coefficient of figure k, for each type of arched surface employed, especially as k is shown in some cases to vary with the angle of flight α; *i. e.*, the inclination of the chord of the surface to the line of translation.

Assuming α constant, however, we may compare the lift of any particular arched surface with a plane surface of the same projected plan and angle of flight.

To illustrate, in the case of the Wright aeroplane, let us assume

$P = 1{,}000$ lb. = total weight $= W$,
$A = 500$ sq. ft.,
$V = 40$ miles per hour $= 60$ ft. per second,
$\alpha = 7$ deg. approximately.

Whence

$$k\sigma = P/2AV^2 \sin \alpha = 1{,}000/(2 \times 500 \times 60^2 \times \tfrac{1}{8})$$
$$= 0.0022 \ (V = \text{ft. sec.})$$
$$= 0.005 \ (V = \text{mi. hr.}).$$

Comparing this value of $k\sigma$ with Langley's value 0.004 for a plane surface V being in miles per hour, we see that the lift for the arched surface is 25 per cent. greater than for a plane surface of the same projected plan. That is to say, this arched surface is dynamically equivalent to a plane surface of 25 per cent. greater area than the projected plan. Such a plane surface may be defined as the "equivalent plane."

Resistance and Propulsion.—The resistance of the air to the motion of an aeroplane is composed of two parts: (a) the resistance due to the framing and load, (b) the necessary resistance of the sustaining surfaces, that is, the drift, or horizontal component of pressure; and the unavoidable skin-friction. Disregarding the frame, and considering the aeroplane as a simple plane surface, we may express the resistance by the equation

$$R = W \tan \alpha + 2fA,$$

in which R is the total resistance, W the gross weight sustained, α the angle of flight, f the friction per square unit of area of the plane, A the area of the plane. The first term of the second member gives the drift, the second term the skin-friction. The power required to propel the aeroplane is

$$H = RV,$$

in which H is the power, V the velocity.

Now W varies as the second power of the velocity, as shown by the first equation, and f varies as the power 1.85, as will be shown later. Hence we conclude that the total resistance R of the air to the aeroplane varies approximately as the square of its speed, and the propulsive power practically as the cube of speed.

Most Advantageous Speed and Angle of Flight.—Again, regarding W and A as constant, we may, by the first equation, compute a for various values of V, and find f for those velocities from the skin-friction table to be given presently. Thus a, R and H may be found for various velocities of flight, and their magnitudes compared.

The question of stability is a serious one in aviation, especially as increased wind velocities are encountered. In machines of the aeroplane type there must be some means provided to secure fore and aft stability and also lateral stability.

A large number of plans have been proposed for the accomplishment of these ends, some based upon the skill of the aviator, others operated automatically, and still others employing a combination of both. At the present time no aeroplane has yet been publicly exhibited which is provided with automatic control. There is little difference of opinion as to the desirability of some form of automatic control.

The Wright aeroplane does not attempt to accomplish this, but depends entirely upon the skill of the aviator to secure both lateral and longitudinal equilibrium, but it is understood that a device for this purpose is one of the next to be brought forward by them. Much of the success of the Wright brothers has been due to their logical procedure in the development of the aeroplane, taking the essentials, step by step, rather than attempting everything at once, as is so often the practise with inexperienced inventors.

The aviator's task is much more difficult than that of the chauffeur. With the chauffeur, while it is true that it requires his constant attention to guide his machine, yet he is traveling on a roadway where he can have due warning, through sight, of the turns and irregularities of the course.

The fundamental difference between operating the aeroplane and the automobile is that the former is traveling along an aerial highway which has manifold humps and ridges, eddies and gusts, and since the air is invisible he can not see these irregularities and inequalities of his path, and consequently can not provide for them until he has actually encountered them. He must feel the road since he can not see it.

Some form of automatic control whereby the machine itself promptly corrects for the inequalities of its path is evidently very desirable. As stated above, a large number of plans for doing this have been proposed, many of them based on gyrostatic action, movable side planes, revolving surfaces, warped surfaces, etc. A solution of this problem may be considered as one of the next important steps forward in the development of the aeroplane.

III. HYDROMECHANIC RELATIONS

At the present moment so many minds are engaged upon the general problem of aerial navigation that any method by which a broad forecast of the subject can be made is particularly desirable. Each branch of the subject has its advocates, each believing implicitly in the superiority of his method. On the one hand, the adherents of the dirigible balloon have little confidence in the future of the aeroplane, while another class have no energy to devote to the dirigible balloon, and still others prefer to work on the pure helicopter principle. As a matter of fact, each of these types is probably of permanent importance, and each particularly adapted to certain needs.

Fortunately for the development of each type, the experiments made with one class are of value to the other classes, and these in turn bear close analogy to the types of boats used in marine navigation. The dynamical properties of water and air are very much alike, and the equations of motion are similar for the two fluids, so that the data obtained from experiments in water, which are very extensive, may, with slight modification, be applied to computations for aerial navigation.

Helmholtz's Theorem.—Von Helmholtz, the master physicist of Germany, who illuminated everything he touched, has fortunately considered this subject, in a paper written in 1873. The title of his paper is "On a Theorem Relative to Movements that are Geometrically Similar in Fluid Bodies, together with an Application to the Problem of Steering Balloons."

In this paper Helmholtz affirms that, although the differential equations of hydromechanics may be an exact expression of the laws controlling the motions of fluids, still it is only for relatively few and simple experimental cases that we can obtain integrals appropriate to the given conditions, particularly if the cases involve viscosity and surfaces of discontinuity.

Hence, in dealing practically with the motion of fluids, we must depend upon experiment almost entirely, often being able to predict very little from theory, and that usually with uncertainty. Without integrating, however, he applies the hydrodynamic equations to transfer the observations made on any one fluid with given models and speeds, over to a geometrically similar mass of another fluid involving other speeds, and models of different magnitudes. By this means he is able to compute the size, velocity, resistance, power, etc., of aerial craft from given, or observed, values for marine craft.

He also deduces laws that must inevitably place a limit upon the possible size and velocity of aerial craft without, however, indicating what that limit may be with artificial power. Applying this mode of reasoning to large birds, he concludes by saying that, "It therefore appears probable that in the model of the great vulture, nature has already reached the limit that can be attained with the muscles as working organs, and under the most favorable conditions of subsistence, for the magnitude of a creature that shall raise itself by its wings and remain a long time in the air."

In comparing the behavior of models in water and air, he takes account of the density and viscosity of the media, as these were well known at the date of his writing, 1873; but he could not take account of the sliding, or skin-friction, because in his day neither the magnitude of such friction for air, nor the law of its variation with velocity had been determined.

Even as late as Langley's experiments, skin-friction in air was regarded as a negligible quantity, but, due to the work of Dr. Zahm, who was the first to make any really extensive and reliable experiments on skin-friction in air, we now can estimate the magnitude of this quantity. As a result of his research he has given in his paper on atmospheric friction the following equation:

$$f = 0.00000778\ l^{-0.07} v^{1.85} \ldots (v = \text{ft. sec.}),$$
$$f = 0.0000158\ \ l^{-0.07} v^{1.85} \ldots (v = \text{mi. hr.}),$$

in which f is the average skin-friction per square foot, and l the length of surface.

Relative Dynamic and Buoyant Support.—Peter Cooper-Hewitt has given careful study to the relative behavior of ships in air and in water. He has made a special study of hydroplanes, and has prepared graphic representations of his results which furnish a valuable forecast of the problem of flight.

Without knowing of Helmholtz's the-

orem, Cooper-Hewitt has independently computed curves for ships and hydroplanes from actual data in water, and has employed these curves to solve analogous problems in air, using the relative densities of the two media, approximately 800 to 1, in order to determine the relative values of support by dynamic reaction and by displacement for various weights and speeds.

An analysis of these curves leads to conclusions of importance, some of which are as follows:

The power consumed in propelling a displacement vessel at any constant speed, supported by air or water, is considered as being two thirds consumed by skin-resistance, or surface resistance, and one third consumed by head resistance. Such a vessel will be about ten diameters in length, or should be of such shape that the sum of the power consumed in surface friction and in head resistance will be a minimum (torpedo shape).

The power required to overcome friction due to forward movement will be about one eighth as much for a vessel in air as for a vessel of the same weight in water.

Leaving other things out of consideration, higher speeds can be obtained in craft of small tonnage by the dynamic reaction type than by the displacement type, for large tonnages the advantages of the displacement of type are manifest.

A dirigible balloon carrying the same weight, other things being equal, may be made to travel about twice as fast as a boat for the same power; or be made to travel at the same speed with the expenditure of about one eighth of the power.

As there are practically always currents in the air reaching, at times, a velocity of many miles per hour, a dirigible balloon should be constructed with sufficient power to be able to travel at a speed of about 50 miles per hour, in order that it may be available under practical conditions of weather. In other words, it should have substantially as much power as would drive a boat, carrying the same weight, 25 miles an hour, or should have the same ratio of power to size as the *Lusitania*.

Motors.—It is the general opinion that any one of several types of internal combustion motors at present available is suitable for use with dirigible balloons. With this type, lightness need not be obtained at the sacrifice of efficiency. In the aeroplane, however, lightness per output is a prime consideration, and certainty and reliability of action is demanded, since if by chance the motor stops, the machine must immediately glide to the earth. A technical discussion of motors would of itself require an extended paper, and may well form the subject of a special communication.

Propellers.—The fundamental principles of propellers are the same for air as for water. In both elements, the thrust is directly proportional to the mass of fluid set in motion per second. A great variety of types of propellers have been devised, but, thus far only the screw-propeller has proved to be of practical value in air. The theory of the screw-propeller in air is substantially the same as for the deeply submerged screw-propeller in water, and therefore does not seem to call for treatment here. There is much need at present for accurate aerodynamic data on the behavior of screw-propellers in air, and it is hoped that engineers will soon secure such data, and present them in practical form for the use of those interested in airship design.

Limitations.—Euclid's familiar "square-cube" theorem connecting the volumes and surfaces of similar figures, as is well known, operates in favor of increased size of dirigibles, and limits the possible size of heavier-than-air machines in single units and with concentrated load.

It appears, however, that both funda-

mental forms of aerial craft will likely be developed, and that the lighter-than-air type will be the burden-bearing machine of the future, whereas the heavier-than-air type will be limited to comparatively low tonnage, operating at relatively high velocity. The helicopter type of machine may be considered as the limit of the aeroplane, when by constantly increasing the speed the area of the supporting surfaces is continuously reduced until it practically disappears. We may then picture a racing aeroplane propelled by great power, supported largely by the pressure against its body, and with its wings reduced to mere fins which serve to guide and steady its motion. In other words, starting with the aeroplane type, we have the dirigible balloon on the one hand as the tonnage increases, and the helicopter type on the other extreme as the speed increases. Apparently, therefore, no one of these forms will be exclusively used, but each will have its place for the particular work required.

GEORGE O. SQUIER

MOSQUITO EXTERMINATION WORK IN NEW JERSEY

PROFESSOR JOHN B. SMITH, in his report to the governor on the work carried on under the law of 1906, shows that up to the end of the summer of 1908 there had been drained 20,292 acres of salt marsh extending from the Hackensack River to the mouth of Toms River on Barnegat Bay. To accomplish this, required 2,723,974 feet of ditching, put in at an actual cost of $44,058, some $12,000 being expended for administration, surveys and other work necessary to control the actual carrying out of the contracts.

During the same period of two years municipalities throughout the state have joined in the mosquito crusade, and have expended considerable sums of money for local work in eliminating breeding areas. The work is all in the direction of permanent improvement and of destroying the breeding localities. Oiling and temporary work is done only when it is necessary to destroy a brood of wigglers that might otherwise hatch before permanent work can be done.

The results have been very gratifying and the migrating marsh mosquitoes were almost entirely absent during most of the summer from the larger cities where drainage work had been done in 1907 or earlier. It developed in the course of the work that the eggs of these salt marsh species retain their vitality for a very long period and that for at least three years after a marsh is drained, there may be ever lessening broods of larvæ found whenever it becomes water-covered by freshet tides or heavy rains. This was interestingly shown by examinations of marsh mud, from areas drained for different periods, and counting the eggs and egg shells on the samples. It is, therefore, a rather slow process to completely clean up such areas, because a few specimens developing under favorable circumstances will provide a small stock of eggs that require three years or more to work out altogether. In the areas drained in 1904, however, practically no eggs were found except in the deepest depressions, and even in these they were very few in number and much scattered.

The season of 1908 was remarkable for the excessive rainfall in early spring, which provided breeding areas for the early brood, far beyond usual conditions, and these afterward concentrated in cisterns, water-barrels, sewer catch-basins and similar localities so that cities were much troubled by them in the entire region where these excessive spring rains prevailed.

If the legislature now in session provides sufficient means, it is expected that the drainage work can be carried to Great Bay during the season of 1909, and in the cities the local committees are already providing against a duplication of last season's experience with the house mosquito.

THE AMERICAN MUSEUM OF NATURAL HISTORY

THE annual meeting of the trustees of the American Museum of Natural History was held on Monday, February 8. The following officers were elected: Henry Fairfield Osborn,

president; J. Pierpont Morgan, first vice-president; Cleveland H. Dodge, second vice-president. The following is an abstract of the president's annual report:

In point of growth the past year has been the most notable in the history of the institution. Partly aided by the Jesup bequest, the total expenditures were $275,419, or $25,000 more than the previous year. Of this the city contributed $159,930.62 and the museum $115,488.38. In the past eight years the museum has expended directly $932,008 on its explorations and collections. The estimated total value of the collections secured during this period by exploration, by purchase, and by gift to the museum is over $2,000,000. For every dollar which has been expended by the city more than a dollar has been added to the enlargement of the collections.

The present endowment fund, including the bequest of the late President Jesup, is $2,048,156.61. To keep pace with the very rapid growth of the city and the demands it is making for public scientific education, an endowment fund of $5,000,000 is needed. In every part of the world the advance of agriculture and commerce and the spread of fire arms is rendering more scarce the objects of natural history of all kinds, including the works of the primitive races of men. It is deemed vitally important to push the explorations of the museum in all parts of the world while it is still possible to secure these fast vanishing works of nature and of primitive man. During the year 1908 and at the present time the museum's explorations extend to the Mackenzie River and the shores of the Beaufort Sea, to Alaska, Vancouver, Alberta and Saskatchewan, the west coast of Hudson Bay and western Labrador; in the United States parties have been spread in Wyoming, Montana, Idaho, North Dakota, Nebraska, Colorado and Florida, also in Central America, and in the south to Nicaragua, the West Indies and Bahama Islands; in Asia special agents are working in Kashmir, China and Corea; among the islands of the Pacific the museum is working in the Philippines, the Solomon Islands, in Tahiti, New Zealand, the South Shetland Islands and in Kerguelan Island.

Popular education has been given a stronger impulse than ever before. The museum was open free to the public every day of the year and on 179 evenings. The gross attendance last year was 1,043,582, in large part due to the exceptional interest in the International Tuberculosis Exhibition. The attendance at public afternoon and evening lectures reached a total of 82,718. The number of children visiting the museum in lecture classes was 10,425. The number of children who were especially guided through the Tuberculosis Exhibition and who listened to lectures on simple means of prevention of this disease was 41,627. These children came from all the high schools of Greater New York and from many distant towns and cities. In the schools of the city 575,801 children were reached by the system of circulating museums.

During the coming year the principal new exhibitions which will be developed are especially the Children's Museum, the Museum for the Blind, the Philippine Exhibition and the Congo Exhibition presented by King Leopold of Belgium. This last is the most complete collection outside of that which is to be seen in the Congo Museum near Brussels. Growing out of the Tuberculosis Exhibition immediate steps will be taken to make a special exhibition of the life and habits of the smaller organisms in relation to health and disease.

During the past year the scientific staff of the museum has been strengthened by the addition of Professor Bashford Dean, a traveler and ichthyologist of international reputation, who has been placed in charge of the fishes and reptiles. Professor Henry E. Crampton, also of Columbia University, has been appointed head curator of the department of invertebrate zoology to succeed Professor William Morton Wheeler, who has resigned to accept a professorship in Harvard University. Dr. Frank E. Lutz has been called from the Carnegie Institution of Experimental Evolution to take special charge of the exhibition of microorganisms in relation to public health. Dr. Alexander Petrunkevitch has been appointed honorary curator of arachnida, and Aarson L. Treadwell, of Vassar College, has been appointed honorary curator of annulates.

THE EIGHTH INTERNATIONAL ZOOLOGICAL CONGRESS

A LETTER recently received from Professor von Graff contains some information concerning the eighth International Zoological Congress, which will be held in Graz, Austria, in August, 1910, under his presidency. The exact dates are not yet determined, but the meetings will follow those of the Anatomical Congress to be held the same month in Brussels.

Graz is a city of about 130,000 inhabitants, beautifully situated at an elevation of 1,500 feet in the foot-hills of the Styrian Alps, and will be best approached by those coming from the west by the picturesque mountain road from Innsbruck. It has narrow, crooked streets in the older parts of the city and fine, new University buildings for the third educational institution of the empire. The city is overlooked by a fine park and it is proposed to have the evening meals served in one of the beautiful resorts in the neighborhood.

The present plans are to have the sessions occupy the week, from Monday to Friday, the general sessions coming in the morning, those of the sections in the afternoon. The number and character of the sections can not be stated at present, as they depend on the number of papers presented. On Saturday the plan is to make an excursion to Leoben, a beautifully situated village in the Styrian Erzberg, spending the night there.

On Sunday the train is taken over the new alpine railroad to Trieste. Monday forenoon is given to a visit to the Zoological Station at Trieste, founded by the late Professor Claus and famous for the character and amount of its work. Then a visit is made to the picturesque villa of Miramar, associated with the name of the unfortunate Maximilian, of Mexico. Rovigno with its zoological station is reached in the afternoon, and in the evening of Monday the steamer is taken for the four days trip down the beautiful and comparatively little known Dalmatian coast, with its mountainous background, its picturesque costumes and its magnificent remains of the later Roman empire. Stops will probably be made at Sebenico, Spalato, Ragusa and Cattaro, and from the latter place a ride of only a few hours takes one over the border and into the strange city of Cetinge, in Herzegovina. Friday brings the party back to Trieste, but arrangements may possibly be made, allowing those who wish, to stop over longer in Dalmatia. Those who return with the party will reach Vienna on Saturday, and the Congress will finally disband on Sunday.

Those who are interested should write to Professor L. von Graff, Graz, Stiermark, Austria, asking that the circulars, when issued, be sent them. Already several Americans have signified their intention to attend.

PROPOSED LINCOLN SCHOOLS OF SCIENCE

THE Minnesota Academy of Science has passed the following resolution:

WHEREAS: This meeting of the Minnesota Academy of Science takes place near the date of the one hundredth anniversary of the birth of Abraham Lincoln, and

WHEREAS: It is suitable and incumbent on the American people, in gratitude for the great service and sacrifice rendered by him to the fundamental elements of American civilization, to perpetuate his name and to honor it by inscribing it in conspicuous places where the youth may frequently be reminded of the excellence of his character, and

WHEREAS: The American Congress has by a commission appointed for this purpose, after long and extended consideration, recommended the construction of a great thoroughfare from Washington City to the battlefield of Gettysburg, and

WHEREAS: Still there seems to be room and opportunity to commemorate the name of Lincoln in a line of science in which he was a prominent actor, and

WHEREAS: It was by his signing and approving of the act of Congress of 1861 establishing the state schools known as Colleges of Agriculture and Mechanic Arts, to the maintenance of which this nation is committed, and which have since been called "National Schools of Science," of the United States, that the science of agriculture and mechanics have been benefited and firmly established in the educational curricula of the country, therefore,

Resolved, That it is the opinion of the members of the Minnesota Academy of Science that the name of Lincoln ought to be applied by Congress to these schools, and that all the literature and all the researches from such schools that may hereafter be published ought to be labeled and

everywhere known as products of the "Lincoln Schools of Science."

It is the opinion of this academy that by so designating these schools, while an immaterial and uncostly honor would be conferred on the greatest American citizen, such honor would be likely to be more influential and more durable in the perpetuation of his memory than the expenditure of large sums of money in material monuments of any kind.

FIRST AWARD OF THE LANGLEY MEDAL

THE first award of the gold medal recently established by the Smithsonian Institution in memory of the late Secretary Samuel Pierpont Langley and his contributions to the science of aerodromics is made to Wilbur and Orville Wright. The board of regents of the institution has adopted the following resolution:

Resolved, That the Langley medal be awarded to Wilbur and Orville Wright for advancing the science of aerodromics in its application to aviation, by their successful investigations and demonstrations of the practicability of mechanical flight by man."

Following the establishment of the Langley medal, Secretary Walcott appointed the following-named gentlemen of known competence in the subject of aerodromics as a committee on award, announcement of which is hereby made: Mr. Octave Chanute, of Chicago, Chairman; Dr. Alexander Graham Bell; Major George O. Squier, U. S. A.; Mr. John A. Brashear, of Allegheny, Pa., and Mr. James Means, formerly editor of *The Aeronautical Annual,* Boston. The Langley Medal was founded "to be awarded for specially meritorious investigations in connection with the science of aerodromics and its application to aviation." The original design to be used for this medal was made by Mon. J. C. Chaplain, of Paris, a member of the French Academy. The medal bears on its obverse a female figure, seated on the globe, carrying a torch in her left hand and in her right a scroll emblematic of knowledge and the words "Per Orbem." The reverse is adapted from the seal of the institution as designed by Augustus St. Gaudens, the special inscription being inserted in the center instead of the map of the world. It is about three inches in diameter.

SCIENTIFIC NOTES AND NEWS

THE Astronomical Society of the Pacific has awarded its Bruce gold medal for the year 1909 to Dr. G. W. Hill for distinguished services to astronomy.

THE eminent mathematician, M. Henri Poincaré, was officially received on January 28 into the French Academy, taking the seat vacant by the death of the poet Sully Prudhomme. M. Fréderic Masson, the historian of Napoleon, made the address of welcome.

LORD RAYLEIGH, who left England with Lady Rayleigh for a six months' tour around the world, has been seriously ill in South Africa, but is now better. He has given up his plan of going to Australia, and will probably finish the winter in Egypt.

THE celebration of Haeckel's seventy-fifth birthday was held in Jena on February 16. As a gift from the American Museum of Natural History to the Phyletic Museum Professor Osborn has sent a series of the large reproductions of Charles R. Knight's restorations of the extinct vertebrates of North America.

DR. S. WEIR MITCHELL celebrated his eightieth birthday on February 15.

PROFESSOR RAMON Y CAJAL, the anatomist, has been created a senator of Spain.

M. LOUIS MANGIN has been elected a member of the Paris Academy of Sciences, in the section of botany, to succeed M. Van Tieghem, who has been elected permanent secretary.

PROFESSOR WILLIAM Z. RIPLEY, of Harvard University, has been elected an honorary fellow of the Royal Anthropological Institute of Great Britain and Ireland, in recognition of his researches in the field of European and American demography.

PORTRAITS of Professor George J. Brush and of Professor William H. Brewer have been hung in the recently fitted-up faculty room of the Sheffield Scientific School, Yale University. Professor Brush and Professor

Brewer both graduated from the school in the class of 1852.

A NUMBER of physicians who have been operated on by Dr. John B. Deaver, of Philadelphia, gave a dinner in his honor at the University Club on February 14. More than 150 physicians are included in this category. A loving cup was presented to Dr. Deaver.

THE election of Professor S. Kitasato, director of the Infectious Diseases Institute, at Tokyo, to the honorary fellowship of the Royal Society has been made the occasion of a dinner given in his honor by a number of his pupils and friends. Congratulatory addresses were delivered by Professor Kitajima and Dr. T. Takaki, director of the Formosan Medical Institute.

THE title of honorary keeper of the Ashmolean Museum, Oxford, has been conferred upon Dr. Arthur Evans "in consideration of his eminent services to the university as keeper of the Ashmolean Museum, extending over twenty-five years." The thanks of the university were also given to Dr. Evans for his recent gift to the museum.

DR. KARL J. OECHSLIN, of Leipzig, for the past year associated with Professor Michael, of Tufts College, began his new work in the Division of Chemistry, Bureau of Science, Manila, P. I., on January 1.

MR. CHARLES S. BANKS has resumed his duties as entomologist in the Bureau of Science, Manila, P. I., after five months spent in America and Europe in the identification of Philippine material. He worked largely on Philippine Culicidæ, Hemiptera and Orthoptera in the British Museum, and with Dr. Bouvier, in Paris, on Mallophaga, and Dr. Leonardi, in Portici, on Coccidæ and Termitidæ.

PROFESSOR J. B. WOODWORTH, of the geological department, of Harvard University, has returned to Cambridge from his extended trip in South America. He left Cambridge last June and has spent the intervening time in scientific investigation in Brazil and on the western coast of the continent. The trip was made possible by the Shaler Memorial Fund and is the first of a series of similar expeditions to be made under the same provision.

MR. GEORGE H. SHULL, of the Cold Spring Harbor Station for Experimental Evolution, has returned from a three-months' trip to Europe undertaken for the purpose of studying scientific and economic plant breeding. He has now gone to California to resume his work on Mr. Burbank's methods and results.

MR. and MRS. C. WILLIAM BEEBE sailed for Georgetown, British Guiana, on February 15, on the Royal Dutch mail steamer *Coppename*. A month or more will be spent in the interior for the purpose of studying the more generalized types of birds inhabiting this country. Mr. Lee S. Crandall will accompany Mr. Beebe as assistant, and the attempt will be made to bring back alive for the New York Zoological Park some of the more interesting birds and other animals.

MR. ELLSWORTH HUNTINGTON, of the geological department of Yale University, sailed on February 10 on the *Majestic* for Southampton. He is going to Jerusalem by the way of Constantinople, taking with him Mr. C. F. Graham, a Yale senior, as assistant. They will study the former shorelines around the Dead Sea. Their plan is to use a folding boat and visit various points on its shores. The special problem to be solved by this expedition is as to whether any of the shorelines record expansions of this sea within historic times. After leaving the Dead Sea some two months will be spent in the study of the geography of Palestine and the Syrian Desert, with special reference to changes of climate and the effect which the geographic environment has had upon the people and their history. The third objective point will be in the lake region of Asia Minor, where some three months will be spent in the study of the same problems of shorelines, climate and man. This expedition is made under the auspices of Yale University, which defrays a portion of the expenses.

PROFESSOR JULIUS STIEGLITZ, of the University of Chicago, will deliver shortly at the University of California a series of eight or ten lectures, on some aspect of chemistry. This will be the first series of lectures on the

Hitchcock foundation, provided for by the bequest of C. M. Hitchcock in 1885.

Sir Jagadis Chunder Bose, M.A., Sc.D., professor of physics and biology at the Presidency College, Calcutta, India, recently lectured at the University of Illinois on the subjects of the polarization of electric waves, the mechanical responses of plants, and the electric responses of plants.

Professor William T. Sedgwick, of the Massachusetts Institute of Technology, will give a series of lectures at the University of Illinois, from April 19 to 24, under the general head of "Science in the Service of Public Health."

A series of public lectures is to be given at Columbia University on March 8, 15 and 22 at 5:10 P.M. by Alexander S. Chessin, professor of mathematics in Washington University, on the gyrostat. The first lecture will be devoted to a brief history of the gyrostat showing its development from a mere toy into a scientific instrument and a mechanism of great value. The second lecture will be on the influence of the world's rotation on the motion of gyrostats, Foucault's top and the applications of the gyrostat to astronomy and to surveying. The third lecture will be upon the gyrostat in modern industries, and will be devoted to the devices for torpedoes, the steadying of ships at sea, the Schlick marine gyrostat, the monorail car, and the experiments of the German navy, all fully illustrated.

At the last meeting of the Middletown Scientific Association, held on February 9, Professor William North Rice spoke on the life of Darwin.

In accordance with the plan which we have already announced, a heroic bronze bust of Darwin, by the sculptor Mr. William Couper, was presented by the New York Academy of Sciences to the American Museum of Natural History on February 12. The address of presentation was made by Mr. C. F. Cox, president of the academy, and the bust was accepted on behalf of the trustees of the museum by Dr. H. F. Osborn, president. Addresses were then made on "Darwin and Geology," by Professor J. J. Stevenson; "Darwin and Botany," by Dr. N. L. Britton, and "Darwin and Zoology," by Dr. Hermon C. Bumpus. In connection with the celebration a special exhibition has been installed in the museum, consisting of Darwiniana and series of specimens and groups of specimens bearing upon the Darwinian theory of evolution through natural selection. The exhibition will continue for one month.

Professor August Weismann finds himself unable, in consequence of his advanced age, to accept the invitation of the University of Cambridge to attend the Darwin Centenary celebrations and to deliver an address.

Dr. George E. Hale, of the Solar Observatory on Mount Wilson, has been appointed a delegate to represent the National Academy of Sciences at the Darwin Celebration at Cambridge.

The Cambridge University Press will present to each invited guest at the approaching Darwin centenary celebration a copy of the first draft of "The Origin of Species," which is being prepared for press and edited by Mr. Francis Darwin. This is the draft of which Mr. Darwin speaks in his autobiography: "In June, 1843, I first allowed myself the satisfaction of writing a very brief abstract of my theory in pencil in 35 pages."

Mr. Walter Morrison Allen, known as a designer of telescopes, died in Cleveland on February 8, at the age of forty-two years.

Mr. Wilfred Huddleston, F.R.S., the eminent British geologist, died at his home at Dorset on January 29, in his eighty-first year. The death is also announced of M. A. Legoux, who for many years occupied the chair of mechanics at Toulouse.

The general secretaries of the British Association have issued a preliminary circular in regard to the meeting at Winnipeg beginning on August 25. No reduction in rates is made by the steamship companies, but special accommodation will be reserved on the Canadian Pacific steamship *Empress of Ireland,* sailing from Liverpool to Montreal on August 13. It is expected that a single fare will be granted on the Canadian railways for the return trip from Montreal to Winnipeg and from Winni-

peg to Victoria. The official party will leave Winnipeg at midnight on September 2 for the trip to the Pacific coast, and will return to Winnipeg on September 13.

THE fiftieth anniversary of the founding of the Paris Society of Anthropology will be celebrated July 7–9, 1909. Anthropological societies and institutions are invited to send delegates. The program includes a discourse by the minister of public instruction and fine arts, an address by the president of the society, a report by the general secretary on the scientific activities of the society since its foundation, and messages from delegates who are to be the guests of the society at a luncheon and a dinner.

THE Royal Institution, London, has received from a lady who wishes to remain anonymous a gift of £10,000.

THE trustees of the Elizabeth Thompson Science Fund are prepared to receive applications for appropriations in aid of scientific work. All applications should reach, before March 15, 1909, the secretary of the board, Dr. C. S. Minot, Harvard Medical School, Boston, Mass.

ACCORDING to the Berlin correspondent of the London *Times* the latest available details of the new German airship Zeppelin II., which will be launched in March, state that the total length of the vessel is 446 feet, the diameter 42 feet 8 inches, and the cubic contents about 530,000 feet of hydrogen. There are 17 ballonets, of which 16 are of india-rubber-treated cotton, and the seventeenth is of gold-beaters' skin, and is supplied by a well-known firm of English aeronauts. The two Daimler motors weigh 798.8 pounds, and produce together about 200 horse power. The two aluminium cars form cabins for the captain, hammocks being provided for the men. The cars are furnished underneath with soft fenders in order to lessen the shock of landing on the hard ground. An immense shed is being built to accommodate Zeppelin II. as soon as it is launched.

THE production of petroleum in the United States in 1908, according to a preliminary estimate made by David T. Day, of the United States Geological Survey, amounted to between 175 and 180 million barrels, an increase between 5 and 9 per cent. as compared with the production of 166 million barrels in 1907. The total value of the product showed an even greater proportionate gain, for the price of oil increased in California and remained steady in other fields except the Gulf. The increases are attributed to steady growth in Illinois and California, though neither field showed phenomenal development.

MR. D. O. MILLS has given to the department of mammalogy of the American Museum of Natural History eight specimens of the fur seal, to be utilized in the preparation of a group illustrating a seal rookery. The specimens were collected at the Pribilof Islands, Alaska, expressly for the museum, by order of Mr. Mills, who had special permission from the Department of Commerce and Labor for their capture. The series consists of male seals two, three, five and seven years old, female seals three and four years old and two pups six weeks old.

BARON DE LENVAL, on the occasion of the Third International Otological Congress, founded a prize of 3,000 francs to be awarded to such person as should invent and produce a small portable instrument materially assisting the hearing of the deaf. As no such instrument has yet been forthcoming to the satisfaction of the international jury appointed to adjudicate upon the matter, the accumulated interest of four years, amounting to about 400 francs, will be awarded as a prize for the best work that has been published during the last four years in the departments of the anatomy, physiology, or pathology of the organ of hearing. Competing works should be sent to the president of the jury, Professor Dr. A. Politzer, I. Gonzagasse 19, Vienna, before the end of February.

UNIVERSITY AND EDUCATIONAL NEWS

THE two hundred thousand dollars required to secure the gift of $600,000 from Mr. John D. Rockefeller for the Harper memorial library at the University of Chicago has now

been secured. A building will be erected, but part of the money has been reserved for an endowment.

President Charles F. Thwing, of Western Reserve University, announces the completion of a $500,000 fund for additional endowment of Adelbert College and the college for women. Of this amount $125,000 was offered by the General Education Board, on the condition that $375,000 be raised by the university.

Hamline University, St. Paul, Minn., has been offered $75,000 by the General Education Board of New York on the condition that it will raise three times the amount, making a total of $300,000, a large portion of which is to be added to the permanent endowment.

The department of engineering of the University of Michigan has received a gift of the library of the late George Y. Wisner and a rotary engine of the value of $7,000 from Mr. J. D. R. Lampson.

Americans who have received honorary degrees at Oxford have made through President Butler, of Columbia University, a gift of $1,200 for the endowment fund.

Lord Winterstoke has offered to give an additional £15,000 towards the proposed Bristol University. This will make a total contribution from him of £35,000.

We are informed that the statement quoted here from the daily papers to the effect that the office of chancellor would be established at the University of Michigan for President Angell to hold after his resignation is incorrect.

The daily papers state that the presidency of Dartmouth College has been offered to Mr. S. W. McCall, member of congress from Massachusetts since 1893 and a graduate of Dartmouth College in the class of 1874. Statements in regard to college presidencies printed in the daily papers seem, however, to have a large probable error.

Dr. Fletcher B. Dresslar, associate professor of education at the University of California, has become head of the department of philosophy and education in the University of Alabama.

Discussion and Correspondence

Harvard University and the Massachusetts Institute of Technology

To the Editor of Science: I note in Science of January 29 a quotation from a Boston newspaper in regard to "Harvard University and the Massachusetts Institute of Technology"; and it seems desirable that certain erroneous impressions conveyed therein should be corrected.

The important misconception in the article in question is implied in the statement: "It seems probable that the taking from the institute by Harvard of two of its leading professors will bring up again the question of a consolidation or of an alliance between these two educational institutions." This is not only not probable; it is entirely unthinkable, to those acquainted with the true situation. The opposition of the faculty and alumni of the institute to this plan is founded on good and substantial reasons, which are too generally understood and respected to be questioned again.

The Technology faculty and alumni did not oppose the proposed alliance from mere pride in the achievements of the institute, or from any narrow fear that it would lose its individual reputation. They simply recognized that Harvard and Technology represent different and incompatible educational ideals. Harvard's ideal is that of graduate scientific schools following a college course based on the elective system. This, so far as engineering goes, is an interesting and promising experiment and one to which Technology can cheerfully contribute two of her honored sons. Technology herself, however, stands for a different ideal, for a combination, from the beginning, of a broad scientific training with the elements of liberal culture, in a four years' course, laid along the lines of a carefully balanced group system of studies. This ideal has not been fully realized; few ideals ever are; yet in the flux of doubt and questioning which seems to have engulfed the world of higher education, the record of what the institute has actually accomplished stands out as one of the

clear and positive achievements of the last half century.

I almost apologize for calling attention to another sentence in the quotation: "The institute, on the other hand, is handicapped by an improper location and insufficient funds to compete successfully against Harvard."

The readers of SCIENCE ought to be assured that while Technology needs, and would gladly receive, gifts for its growing work, it has so far been able to make both ends meet without serious difficulty. The new president, Professor Maclaurin, experienced in education on three continents, comes to the institute with complete enthusiasm for its special ideals. A body of eight thousand alumni and past students stand ready for loyal service. The institute is now contemplating a move from its present location, which it will soon outgrow, to a new and ample one where a group of buildings worthy of its dignity will be erected. "The Old Technology, with its old traditions and its old ideals, new built on a new site," as acting President Noyes recently phrased it, will not "compete against Harvard"; but it will welcome the McKay school of applied science as a worthy ally in the great war against ignorance that we are all waging together.

C.-E. A. WINSLOW

THE RIGHT AND THE WRONG IN POPULAR SCIENCE BOOKS

To put in simple and elegant language descriptions and explanations of natural phenomena is to offer every one that knowledge and understanding that broadens our sympathies; that increases our interest in the world about us; that makes us more contented and more useful human beings. No nobler work than this can any man do—the work that Tyndall, that Sir Robert Ball, that Darwin and many another devoted follower of nature loved so much and did so well. The popular books that men like these produce can never be too numerous, nor can the publisher devote to them more of his beautifying art than they deserve.

Unfortunately, however, there is another class of books with natural phenomena for their titles; books, of which the one under review is typical, attractively written and prettily illustrated, but filled with false explanations—counterfeit mental coin palmed off on the innocent, to their inestimable harm. Such books do not spread knowledge, nor do they even leave the mental tablets of the uninformed receptively blank, but, on the contrary, scribble all over them an almost ineradicable jumble of errors, which must somehow be got rid of before the unfortunate victim is ready even to begin to learn the truth.

Surely the author of a book treating of a scientific subject must know that he knows what he is talking about, or know that he doesn't know. In the first case, let his explanations be simple, clear, complete. In the second let him have sufficient judgment to leave attempted explanations alone, for they are sure to be wrong, and therefore harmful.

But the fault is not alone with the author. The publisher is expected, and properly so, to guarantee, to the best of his knowledge, the accuracy of the books he offers for sale. And this, it would seem, should impose upon him the duty of submitting all manuscripts of popular nature-books to competent specialists. In this way "Water Wonders Every Child Should Know,"[1] like many another of its kind, might easily have been made the excellent book that at first glance it appears to be, instead of the thing of blunders it actually is.

This little book is beautifully got up, attractively written and filled with many of Mr. Bentley's choicest snow and frost photographs, but as it now stands it can be recommended to those only who already have a knowledge, sufficient to protect them from its errors, of the subjects, dew, frost, snow, ice and rain, of which it treats; and to them simply for its beautiful pictures. But these latter are so numerous and so beautiful that it is to be hoped that there will soon be a new and properly revised edition, one that can be recommended for the accuracy of its explanations as well as for the beauty of its illustrations.

W. J. HUMPHREYS

[1] Jean M. Thompson, "Water Wonders Every Child Should Know," Doubleday, Page & Co., 1907.

QUOTATIONS

THE UNIVERSITY PRESIDENT AND THE UNIVERSITY PROFESSOR

In Professor A. Lawrence Lowell's first formal address as president-elect of Harvard University, printed in the *Harvard Bulletin*, he says:

> It is commonly thought that President Eliot has ruled Harvard and the faculty with a heavy hand. It is not so. When I went to Cambridge one of my colleagues said to me: "If you fail to give satisfaction you will go; but so long as you give satisfaction you may teach as you please." That has been President Eliot's method of treating his subordinates, the members of the faculty.

Is it to be understood that as president of Harvard University Mr. Lowell proposes to retain his subordinates only so long as they give him satisfaction?

The president of another great university has recently expressed his opinion of the relation between the university president and the university professor. In his recently printed lectures before the University of Copenhagen, President Butler, of Columbia University, writes:

> Almost without exception the men who to-day occupy the most conspicuous positions in the United States have worked their way up, by their own ability, from very humble beginnings. The heads of the great universities were every one of them not long ago humble and poorly compensated teachers.—An 'Umble Professor in *The Nation*.

MAMMALS IN THE CONGRESS

Mr. Macon—"Another question. I notice that it is proposed to preserve mammals. What kind of mammals are there up there? I notice here some mammals that you want to preserve there. What are mammals, and of what use will they be to the government?"

Mr. Gronna—"So far as I know, there are no mammals on the islands. The species of birds we have, I have mentioned. We have also the white pelican——"

Mr. Macon—"Are these mammal birds?"

Mr. Gronna—"We have on those particular islands birds that are found nowhere else in the United States, I will say to the gentleman from Arkansas. We have the white-winged scoter, that is not found anywhere else in the interior of this country."

Mr. Macon—"But I want to know about the mammals."

Mr. Gronna—"I am not discussing or referring to mammals."

Mr. Macon—"But I want to know about them."

Mr. Gronna—"I am talking about birds."

Mr. Macon—"I have understood they are something like rats, gophers, or something of that kind."

Mr. Humphreys—"Or 'possum."

Mr. Macon—"Oh, no——"

Mr. Gronna—"I will say in reply to the gentleman from Arkansas that if there are any mammals there of any value we will be very much pleased to preserve them."

Mr. Macon—"But what are they good for?"

Mr. Gronna—"I say we have none that I know of."

Mr. Macon—"What are they good for, or what would they be good for if they were there?"

Mr. Gronna—"I will say to the gentleman from Arkansas that my reply to the gentleman was this, that if there are any mammals of any value we would desire to preserve them."

Mr. Macon—"I am trying to get at what they are good for, but it seems that the gentleman can not inform me."

SCIENTIFIC BOOKS

Pulmonary Tuberculosis and Its Complications. By Sherman G. Bonney, M.D., Professor of Medicine, Denver and Gross College of Medicine, Denver. 8vo, pp. 778, with 189 original illustrations, including 20 in colors and 60 X-ray photographs. Philadelphia and London, W. B. Saunders Company. 1908. Cloth, $7 net; half morocco, $8.50 net.

Dr. Bonney has given us a most valuable book, and one replete with interest. It embodies "largely the results of personal experience." Dr. Bonney has for many years enjoyed a large practise, and has had unusual opportunities for clinical study, which have

been put to good use. His observations and conclusions have therefore great value.

While the book is, as he says, designed for the general practitioner, one of the best written and strongest portions is Part VI., section I., in which he deals with Prophylaxis. Under this general head we find discussed Notification and Registration, Education for the Consumptive and the Public, the giving of Material Aid, and Administrative Control. These chapters are well adapted for general reading, and we wish that the educated public, and especially those charged with the making and administration of our laws, could be forced to study them. A single quotation only can be given:

> Society, which sometimes encompasses the regular and legitimate practitioner of medicine with embarrassing restrictions, yet permits the unsuspecting invalid to become the non-defensive prey of ignorant and unscrupulous charlatans. While many forms of quackery have been overlooked, and the advertisement and sale of patent medicines containing alcohol and various narcotics have been permitted, the state, by virtue of its failure to enact repressive legislation or to enforce existing laws, has become indirectly responsible for the lack of public health.

At present interest is again turned to the relation between bovine and human tuberculosis. Dr. Bonney's conclusions are in the main sound and practical. While admitting the danger to man from cattle, he says: . . . "among individuals a greater virulence attaches to the bacillus of human origin than to the bovine." This statement is incorrect. If it means that the consumptive man is the chief source of danger to man, we will agree with it, but no one has ever shown that the human bacillus is more virulent for man than the bovine germ, and there is good reason to believe that the contrary is true.

The discussion of staining is meager, and no mention is made of the non-acid-fast forms of the tubercle bacillus, a most important matter pointed out by E. Klebs, Much, Michaelides, Herman and others. What he says against waiting to make a diagnosis until tubercle bacilli are found in the sputum is eminently sound. Much valuable time is lost, and many lives sacrificed by this wide-spread, but most pernicious, practise.

The methods given for isolation of cultures are incorrect.

The sections of the book which will probably most interest the practitioner are those on diagnosis, symptomatology, complications and treatment. These occupy the major portion of the book, and are illustrated by many excellent and well-chosen cuts.

The classification of cases is not in accordance with the modern trend, and no mention is made of the classification advised by the National Association.

The subject-matter in these sections is very full and contains a vast amount of practical knowledge.

Sixty X-ray photographs are given, most of them excellent. Dr. Bonney properly regards the X-ray as a valuable aid to diagnosis. He considers the "legitimate scope of the subcutaneous tuberculin test to be extremely limited," though he says it is "not only harmless, but has a high diagnostic value" when intelligently employed. While recognizing the care necessary in the use of tuberculin, we believe its use should be extended, and in view of what he says, it is illogical to limit its use as he does.

Dr. Bonney is an advocate of the most pronounced type of the climatic treatment of tuberculosis. For him the ideal climate is found in Colorado, especially in Denver and Colorado Springs. Even in those features which apparently detract from the perfect ensemble, he finds "concealed" desirable features. It would be hard to imagine a more marked contrast than his description of Colorado and the Adirondacks. The latter he says have a comparatively small number of sunny days, moderate humidity, and an abundance of clouds, fog, snow and rain, yet admits that they have a "well-deserved reputation as a place of sojourn for pulmonary invalids." From his description certainly no more unsuitable climate could be found, yet we know that the results obtained there are among the best in any part of the world.

His reiterated advice concerning "regard for infinite detail" in the treatment of tuber-

culosis is to be most highly commended, and we suspect that much of the good he attributes to climatic influences is due to this minute personal attention, which is the keynote of successful treatment in any climate. It would be fairer, and the arguments have more weight, if Dr. Bonney proved by statistical comparison the marked advantages of Colorado over what he considers less favorable regions.

In the treatment of hemorrhage on page 717, Dr. Bonney wisely, we think, advises against the use of all drugs calculated to reduce the volume of blood in the lungs, as worthless and harmful. On page 722, however, he speaks highly of placing ligatures around the extremities, which act by reducing the volume of blood, though the pathologic changes which prevent the contraction of the vessels at the site of bleeding must act with equal force in both cases.

The chapter on Theories of Immunity is the weakest part of the book, and should be omitted in the future, or re-written. The text is far from clear, and many inaccurate expressions are used, such as "toxic infection," "receptor cells," "protective poisons," "bacilli emulsion," etc. If his description of an antitoxin means anything it is that antitoxins consist of an excess of haptophores!

In describing Wright's technique we are told that the film is so spread as to insure even distribution of the cells. This is exactly what we try to avoid, Wright having devised a special method of spreading with the end of a slide for the purpose of pressing the leucocytes to the edges and end of the smear, to facilitate counting.

The *italic* is overworked throughout the book.

The names of Lassar, Delépine, Vallée, Gabbett, Descos and Larrier are misspelled.

It is more easy to pick flaws than to construct a book, but in a work of such general excellence, it is particularly disappointing to find such defects as have been pointed out.

The printing is good, and the illustrations throughout are first class, from the technical, as well as the educational standpoint.

In spite of the defects, and though we may not agree with Dr. Bonney in some of his views, we consider the book a valuable addition to our knowledge of the terrible disease of which he treats. Not only the general practitioner, for whom the book is written, but the specialist will find it well worth careful study.

Mazÿck P. Ravenel

The World's Gold. A Discussion of the Geological Occurrence of Gold, Its Geographical Distribution, Its Extraction and Methods of Milling, and the Economy of Gold. By L. De Launay, Professor in the École Supérieure des Mines. Cloth; 5½ x 8⅛ ins.; pp. 242. $1.75 net. New York, G. P. Putnam's Sons.

The preface of this work is an interesting thesis on the function of gold in the world's industrial development. According to the author, it is not only the basis of all wealth, but it is "the whole of wealth"; furthermore, it is a great civilizer and one of the most powerful agencies making for the development of the resources of the world.

The chapters on the geological occurrence and geographical distribution of gold are of necessity, in a work of this character, unsatisfactory and far from exhaustive. The same may be said, and with greater force, of the chapter on extraction and dressing of gold ores—practically no definite or clear ideas can be acquired by a perusal of these chapters. However, from the standpoint of the economist, scientific details are not necessary.

The main value of this work lies in the chapter on the Economy of Gold, and it may be said that in this respect it is a positive and exceedingly valuable addition to the literature on the relation of gold to money and commerce.

L. de Launay examines the problem of the future supply of gold from the scientific standpoint and correlates the influence of this supply with prices and the movement of capital from the financial standpoint. Thus he performs the rare service of welding together the technical and economical aspects of the subject.

Taken as a whole, the work is well and logically written and fairly accurate in facts and figures. It is a work which will be read with interest by both technical and non-technical readers, and especially by those interested in the financial aspect of money and metals.

WALTER R. CRANE

On the Witness Stand: Essays on Psychology and Crime. By HUGO MÜNSTERBERG, Professor of Psychology, Harvard University. Pp. 269. New York, The McClure Co. 1908.

Professor Münsterberg writes as the champion of a cause. A new science is taking shape. Fifty laboratories are its servants. It is applied psychology (p. 9). Education, medicine, art, economics and law are its natural fields; but the obdurate lawyer bars it out of the last.

The reader of these essays, who is familiar with the practise of courts, will question if the author gives them sufficient credit for the rules which they have themselves worked out to aid them in the search for truth. His criticisms are addressed to those in which the trial is by jury, and there is no examination of the accused by the presiding judge. The American juryman is commonly of more than average education and ability, else he would not be found upon the panel. Among twelve such men there will be those who have met, not only the ordinary, but some of the extraordinary experiences of life. They all know what strong emotion is. They are no strangers to the force of temptation, of suggestion, of the association of ideas. They are in one respect, and that an important one, more competent to weigh the value of testimony than a professor of psychology, because they are nearer to the ordinary witness in character and circumstance. They have learned from a lifetime of buying and selling, of giving and obeying orders, of hiring and discharging, of hearing news and telling news, how difficult it is for two men to see or understand a thing in exactly the same way, and how impossible it is for them to describe it exactly in the same way.

The lawyers and judges, too, have been schooled in certain rules of evidence. Professor Münsterberg is wrong when he says (p. 22) that they hope to get the exact truth, when they ask some cabman how much time passed between a cry and a shot. They know, and the jury know, that what seems to some a space of minutes, will seem to others, and perhaps with better reason, a space of seconds. Witnesses may differ on the size or length or form of a field, "and yet," says the author (p. 33), "there is no one to remind the court that the same distances must appear quite differently under a hundred different conditions." He would have the psychologist intervene, and explain all this to a dozen men whose every-day experience has taught it to them from boyhood.

So when he declares (p. 44) that "the confidence in the reliability of memory is so general that the suspicion of memory illusions evidently plays a small rôle in the mind of the juryman" and cross-examining lawyer, he discredits their intelligence on quite insufficient grounds.

Professor Münsterberg would have witnesses examined by a psychologist (pp. 46, 62) with regard to their powers of perception and memory, their faculty of attention, their lines of association, the strength of their volition, and their impressibility by suggestion. He does not tell us whether he would have this examination take place in or out of court. If in court, it is obvious that it would greatly multiply the questions for the jury to decide, and be mainly unintelligible to them except as supplying a basis for the examiner's ultimate conclusions: if out of court, it would involve wearisome statements, probably from more than one expert, of the experiments tried, and open the way to a still more wearisome cross-examination. In either case, the prospect of submitting to such an ordeal would make many men and more women unwilling to testify in court, and so tend to dissuade them from letting it be known that they are cognizant of material facts.

The author urges a resort to the association-test, or the automatograph, in the case of those charged with crime; saying that (pp. 82, 124, 132) a guilty man, of course, will not object,

since he can not refuse and yet affirm his innocence. This ignores the settled construction of the provision in all our constitutions that the accused can never be compelled to give evidence against himself.

The effect of suggestion on a witness is spoken of as something to be understood and explained only by a professed psychologist (p. 158). The rule of all Anglo-American courts which excludes questions naturally leading to a desired answer as to a material fact, shows how well jurists have appreciated this particular tendency of the human mind.

The position of the Lombroso school that a criminal, like a poet, *nascitur, non fit,* is pronounced untenable (p. 234). We are all potential criminals; not actually such, largely, because we are afraid of unpleasant consequences, and society has been so kind as to environ us with circumstances favorable to the development of this fear (pp. 238, 250, 266). The clearest sources of pure life are (p. 262) "the motives of private, personal interest between human being and human being."

Disrespect for law the author counts as an important cause of crime. In that view, it is questionable whether he was wise in giving so much space to the psychological aspects of two recent murder trials; that of Moyer (p. 92), in which he made a scientific examination of the main witness for the state and concluded that he was an honest one, though the jury did not believe him, and another in Chicago (p. 163), where a man was hanged upon his own confession, whom Professor Münsterberg, without having examined him, pronounced innocent.

Like all that comes from the author's prolific pen, this book is thoughtful and suggestive. It would be more valuable if, instead of dwelling solely on the aid which psychological experts could render to courts, he had also discussed the practical difficulties which lie in the way.

Simeon E. Baldwin

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for February contains the address of Charles F. Cox, president of the New York Academy of Sciences, on "Charles Darwin and the Mutation Theory." The author presents many facts to show that Darwin was well aware of the tendency of many species to sudden and marked variations, these variations being perpetuated, but that, nevertheless, he was convinced that this was exceptional and extraordinary. Such being the case, he would scarcely have subscribed to De Vries's *dictum* that species and varieties have originated by mutation and at present are not known to have originated in any other way. Robert F. Griggs presents the second, and concluding, part of his article on "Juvenile Kelps and the Recapitulation Theory," the decision being that except as some tendency has operated to change the heritage the history of the individual does recapitulate the history of the race.

The Zoological Society Bulletin for January opens with part two of a paper on the "New World Vultures," by C. William Beebe. This is largely devoted to the California condor, but also contains an account of an interesting experiment to test the sense of smell in the vultures; it seems to be almost lacking, and is best developed in the turkey buzzard. There is an account of how the hippopotamus was moved to the new elephant house and a note giving the weights of the elephants and rhinoceroses. Hunting song birds has not ceased entirely in the vicinity of the park and they are occasionally sought with shot-gun and traps.

The Museums Journal of Great Britain contains, besides its many interesting notes and reviews, "The History of the Ipswich Museum," by Frank Woolnough, and an article by L. Wray, on "The Preservation of Mammal Skins." This is of importance from the fact that the writer gained his experience in the Perak Museum, where he had to contend with the hot, moist climate of the tropics.

The Bulletin of the Charleston Museum for January contains the report of the director for 1908, which notes the good progress made during the year, especially in the development of the library, which is the only free public library in the city.

The Museum News of the Brooklyn Institute for February notes various advances during the year 1908 and a great gain in attendance, the number of visitors at the Central Museum having been 203,940 and at the Children's Museum 117,182, a total increase of 54,000 over 1907. There is an article on "The Games of the Cliff-Dwellers" and another on the almost lost art of "Scrimshawing." A number of "Additions to the Insect Collection at the Children's Museum" are noted and a list is given of zoological charts for loaning to schools.

SOME of the English Museums from time to time issue extremely good handbooks at astonishingly low prices. A recent publication of this kind is the Handbook to the Weapons of War and the Chase in the Horniman Museum, London, written by H. S. Harrison, curator of the museum, and edited by A. C. Haddon. This book of 73 pages describes a great variety of weapons and includes a list of some of the books and papers on the subject in the Museum Library and sells for twopence, or by post, threepence.

IN the *Report on the Illinois State Museum of Natural History,* Dr. A. R. Crook, the curator, makes a strong plea for the establishment of a museum worthy of the state of Illinois, showing by statistics and illustrations how much has been done by other states and how much may be done in Illinois.

THE RIABOUSCHINSKY EXPEDITION UNDER THE AUSPICES OF THE IMPERIAL RUSSIAN GEOGRAPHICAL SOCIETY[1]

I AM grateful to the society for the opportunity extended to me to give a brief outline of the organization and aims of the Riabouschinsky expedition. In fact, I believe that you are just as much interested in the results to be attained by this expedition as we are in Russia, because a good part of my investigations are to be made on American soil.

The patron of this expedition is Mr. Theodor Riabouschinsky, a well-known capitalist in Moscow. He is a very young man, and during his studies in the Moscow university he paid particular attention to anthropology. He conceived the idea of undertaking a thorough investigation of the Kamchatka Peninsula. The importance of this investigation will be realized when I will tell you that Kamchatka has been under Russian control for about three hundred years and has been visited by many noted travelers, yet very little is known about the country. Up to about fifty years ago Kamchatka was the only open door Russia had to the Pacific Ocean, and at that time the government took some interest in that country; but since the Amour River has been acquired by Russia, the government has neglected that peninsula completely. For this reason the great service rendered to science by a private undertaking will be appreciated.

Mr. Riabouschinsky requested the Imperial Russian Geographical Society to organize at his expense a scientific expedition to Kamchatka. This society organized an expedition consisting of five divisions: Zoological, botanical, geological, meteorological and ethnological. The zoological division is headed by Peter Schmidt, professor at the University of St. Petersburg. He and his four assistants, representing the different branches of zoological science, are to investigate the fauna of Kamchatka. Komaroff, the chief botanist of the Imperial Botanical Garden in St. Petersburg, is the leader of the botanical division. He has four assistants and has to study the flora of Kamchatka and its distribution. The geological division consists of two independent sections—one headed by Krug, a mining engineer, is to study the general geology and topography of Kamchatka; the second section, headed by Konradi of the Russian Geological Survey, is to direct a special investigation of the volcanoes in Kamchatka. The meteorological division, consisting of five members, under the direction of Vlassoff, of the observatory of St. Petersburg, will study the climate of that country. All these four divisions are already on that peninsula, busily engaged in their respective investigations, which, it is presumed, will last about two years.

[1] Paper read at the meeting of the American Ethnological Society, November 9.

The ethnological work was entrusted to the writer of this paper. While accepting the invitation to make this ethnological investigation, I proposed that the area to be studied by my department should be extended so as to include the Aleutian and Kurilian Islands. My reasons were that the northern Kamchadal have already been studied by the Jesup expedition, and the southern Kamchadal are already Russianized to such a degree that archeological work alone, and some relics of the former material culture, can give us some direct indications as to the primitive life of the Kamchadal. Even the somatological work becomes uncertain in many localities where the intermixture with Russians was especially extensive. The position of an ethnologist in Kamchatka should not be judged by the standard of a naturalist who undertakes studies there. While nature has not changed there since the Russians came there, this is not the case with man. The old Kamchadal beliefs, manners and customs are disappearing; some traits, in fact, have already vanished, leaving hardly any traces behind. It seemed to me, therefore, that two years of field work among the Kamchadal alone would not be sufficiently remunerative from a scientific standpoint. On the other hand, the ethnology of the Kamchadal can not be investigated, to any great extent, without the study of the neighboring tribes. The Jesup expedition in its endeavors to clear up the history of the American tribes has already investigated the tribes nearest related to the Kamchadals; I refer here to the Koryak, Chukchee and Yukaghir tribes, as well as to some remotely related tribes, such as the Giliak and Ainu. The nearest neighbors of the Kamchadals in the east are the Aleut. You are undoubtedly aware of the fact that the extreme western Aleutian islands are separated from the eastern shores of Kamchatka by only about three hundred miles, in the center of which are situated the Komandorski islands. And the Aleut have as yet not been sufficiently studied. Even the Jesup expedition has not succeeded in studying this most interesting tribe.

Another object of my study is to investigate the former relations of the Kamchadal to the Ainu. This can only be achieved by a study of the Kurilian islands. In order to attain this, I propose to remain only one year in Kamchatka and to devote the other year of my work to the Aleutian and Kurilian islands. In this manner my work will extend outside of the geographical limits within which the other divisions are working. I decided to spend the first year of my studies among the Aleut. To reach the Aleutian islands I found it advisable to take the western route, by way of America, and on this account my party has had to be separated from the other divisions of the expedition.

Concerning the investigations of the Aleut, I can say the same as I said about the Kamchadal. Under the Russian rule they have been Russianized to such a degree that ethnology has lost considerably. Much, however, can be done even now. We must endeavor to reestablish the past by a study of what remains of their old habits and customs, and their former family and social relations and material culture. It will also be very difficult to define the physical type of the present Aleut, considering the extensive intermixture which has taken place between them and the Russians. But their language is still available for study, and it is important to define the relation of the Aleut language to the Esquimo dialects. It is also important to make new excavations, considering that Dall has found traces of different cultures on the Aleutian islands.

The investigations I plan to make consist essentially in a continuation of my work done for the Jesup expedition. I have in view to contribute to the solution of some problems which have already been raised by the Jesup expedition. It is significant that during the period from 1900 to 1902 I have made investigations on Russian territory on behalf of an American scientific institution, and that I am now on my way to carry on an investigation of the same nature on American territory on behalf of a Russian scientific society. May this serve as an additional proof of the

established adage that science is international in its scope. After all, the results of every scientific investigation become common property, irrespective of the nation which undertakes the work.

My route will be about as follows: At Seattle I will embark on December 8 on the steamer *Pensilvania,* reaching Seward within a week. There I shall take another steamer, the *Dora,* which goes directly to Unalaska. I do not know as yet exactly in what manner I shall travel around the Aleutian islands. At present only three islands are inhabited: Unalaska, Atka and Attu.

But for excavation purposes I must also visit some other islands which are not populated at present, but were so in the past. In the spring of 1910 I expect a Russian naval cruiser to come and take me and my party from the Aleutian islands to the Komandorsky islands, and from there to Petropavlovsk in Kamchatka. Kamchatka I intend to study not only along the coast, but also in the interior. In the north I shall try to reach the bay of Baron Korf, and in the south to go as far as Cape Lopatka. Everywhere I shall endeavor to make excavations of old Kamchadal villages. In the spring of 1911 I hope to return to Russia by way of Vladivostock, visiting on the way some of the Kurilian islands.

My party consists of myself and two assistants, one of whom is my wife, who also accompanied me on the Jesup expedition. Mrs. Jochelson will act in the capacity of both physician and somatologist.

In closing I wish to express for myself, as well as for the Russian Imperial Geographical Society, my gratitude to the governmental and scientific institutions of New York and Washington for the assistance and attention shown me while preparing for my journey. The secretary of the interior has kindly granted me, at the request of the Russian embassy, permission to make excavations on American territory. The secretary of the treasury has promised to issue the necessary orders to take me from the eastern to the western Aleutian islands by revenue cutter. The Smithsonian Institution and other scientific bodies have furnished me with many publications, and maps and also with recommendations, all of which are very valuable to me. The American Museum of Natural History have extended to me their kind hospitality, which I appreciate, and for which I am under obligations to the president and the director of the museum.

WALDEMAR JOCHELSON

ST. PETERSBURG

THE AMERICAN CHEMICAL SOCIETY

THE Baltimore meeting of the American Chemical Society was more largely attended than any previous meeting the society has ever held and was unusually enthusiastic from beginning to end.

The local committee had made special arrangements for the entertainment of the visiting chemists, consisting of banquet and smoker, automobile rides, parties and dinners for the attending ladies, and excursions to Annapolis, to the Maryland Steel Company's works, to the various Baltimore breweries, to Sharp & Dohme's works and to various points of interest around the city. In this respect the city of Baltimore kept fully up to its general reputation for hospitality.

Some four hundred and twenty-five chemists were present and attended the various sectional meetings of the society besides the addresses given in general session.

These general addresses have proved a very attractive feature of recent meetings and those delivered at Baltimore before the whole society were:

"The Untilled Field of Chemistry," by A. D. Little.

"The Use and Abuse of the Ionic Theory," by Gilbert N. Lewis.

"The Work of Werner on the Constitution of Inorganic Compounds," by Chas. H. Herty.

"The Future of Agricultural Chemistry," by H. J. Wheeler.

"The Quantitative Study of Organic Reactions," by S. F. Acree.

"The Classification of Carbon Compounds," by Edward Kremers.

"The Efficiency and Deficiencies of the College-trained Chemist when Tested in the Technical Field," by Wm. H. Nichols.

"To what Extent should College Training Confer Practical Efficiency along Technical Lines?" by Louis M. Dennis.

"The Attitude of Technical Institutions to Post-graduate Study," by Wm. McMurtrie.

To these should be added the retiring addresses

of President M. T. Bogert of the American Chemical Society on "The Function of Chemistry in the Conservation of our Natural Resources," and of H. P. Talbot, vice-president of Section C of the American Association for the Advancement of Science, on "Science Teaching as a Career."

Over one hundred and sixty papers were announced and read before the nine different sections into which the meeting was divided. Many of these papers were of far-reaching interest and the sections were fully attended. It is probable that no one of the sections was more enthusiastic than the recently organized Division of Industrial Chemists and Chemical Engineers, which was in session on four separate days and whose meetings were unusually enthusiastic. The paper of E. G. Bailey, on "Accuracy in Sampling Coal," proved of such great interest to the members that the discussion was allowed to continue for over two hours and the paper of W. H. Walker, describing a new method of quickly finding imperfectly covered spots on tin plate, aroused almost equal discussion and interest among the chemists present.

The Section of Physical and Inorganic Chemistry, the Section of Agricultural and Food Chemistry, the Section of Organic Chemistry and the Section of Fertilizer Chemistry having petitioned the council for permission to organize as divisions of the American Chemical Society the following divisions were authorized and have organized and elected officers: Division of Physical and Inorganic Chemistry, Division of Agricultural and Food Chemistry, Division of Organic Chemistry, Division of Fertilizer Chemistry.

Charles L. Parsons,
Secretary

THE THIRTY-NINTH GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY AND THE MEETING OF SECTION C OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The thirty-ninth general meeting of the American Chemical Society and Section C of the American Association for the Advancement of Science was held at the Woman's College in Baltimore from Tuesday, December 29, to Friday, January 1, 1908–9.

On Tuesday morning Section C was organized and this was followed by the opening session of the American Chemical Society. After the general meeting in the afternoon the following addresses were given before the Section of Chemical Education:

The Efficiency and Deficiencies of the College-trained Chemist when Tested in the Technical Field: William H. Nichols.

To what Extent should College Training Confer Practical Efficiency along Technical Lines: Louis M. Dennis.

The Attitude of Technical Institutions to Post-graduate Study: William McMurtrie.

This section was well attended and the greater part of the afternoon was spent in the discussion of the papers.

On Tuesday evening a complimentary smoker was given at the Belvedere Hotel by the Baltimore Section of the society. The smoker was preceded by an illustrated lecture on the "Lumiere Process of Color Photography," by William Simon.

On Wednesday afternoon excursions were made through the Naval Academy at Annapolis; through Sharp and Dohme's drug factory, and also the Baltimore breweries.

On Thursday evening a subscription dinner was given at the Belvedere Hotel. This proved to be one of the most pleasant events of the meeting.

On Friday afternoon an excursion was made through the Maryland Steel Works.

On Saturday many of the chemists visited the Bureau of Standards and Geophysical and other laboratories in Washington.

The following addresses were given before the general assembly:

The Function of Chemistry in the Conservation of our Natural Resources: President M. T. Bogert.

The Untilled Fields of Chemistry: A. D. Little.

The Use and Abuse of the Ionic Theory: Gilbert N. Lewis.

Science Teaching as a Career: H. P. Talbot.

The Work of Werner on the Constitution of Inorganic Compounds: Chas. H. Herty.

The Future of Agricultural Chemistry: H. J. Wheeler.

The Quantitative Study of Organic Reactions: S. F. Acree.

The Classification of Carbon Compounds: Edward Kremers.

The following papers were reported before the various sections:

Agricultural and Food Chemistry

H. J. Wheeler, chairman

Analyses of Milk Products: Edward Gudeman.

This paper gives comparison of results obtained in the determination of fat, using the standard or official methods and a new method for fat

determination in milk products such as condensed milk, evaporated milk, malted milk, milk powders, milk chocolate, milk cereal products and candies containing milk products or other fats.

The new method suggested is so simplified as to give correct results in the hands of chemists not having special experience in the analyses of such products, besides materially decreasing the time of making analyses. A weighed quantity of the product is dissolved in water or made into an emulsion, the fat and proteids precipitated with copper sulphate, filtered on a fat-proteid free paper, allowed to drain and the damp precipitate on the paper directly extracted with ether. The extracted precipitate is used for making proteid determination by the Kjeldahl method, digesting paper and precipitate. Filtrate from the copper sulphate precipitation is used for determination of sugars and gums. If insoluble starch is present, a weighed filter paper is used and starch determined as difference between total weight of precipitate and proteid and fat found.

Carbohydrates such as starch, dextrines, gums and sugars (cane, maltose, lactose and dextrose) interfere with complete extraction of fat with solvents and in the separation of the fat by the modified Babcock method. Drying the milk product for extraction, direct and after soaking in water, will give low results, due to change in fat during drying (Gudeman, *Proceedings A. O. A. C.*, 1902).

The analyses of milk products containing sugars or cereals or gums are not accurate and it is recommended, therefore, to confine such analyses to the determination of water, ash, fats, proteids, soluble carbohydrates, insoluble carbohydrates and to qualitative examination for starch, dextrine and gum.

The paper reviews the collaboration work done by the A. O. A. C. on condensed milk and evaporated milk during 1907 and 1908.

Effect of Fresh Manure on Denitrification and Plant Growth: E. B. FRED.

This includes the results of field, pot and laboratory experiments with fresh manure containing large amounts of straw. The effect was studied in experiments, where fresh manure was compared with well-rotted manure, with and without the addition of nitrate of soda. The loss due to denitrifying bacteria present in the straw was measured by its effect on plant growth.

The Colorimetric Determination of Nitrates in Soil Solutions containing Organic Matter: W. A. SYME.

Potassium permanganate is added to the hot soil solution, acidified with sulphuric acid, until in excess. The solution is filtered, made alkaline with sodium carbonate and evaporated to dryness on water-bath. The residue is treated with water, filtered and diluted to its original volume. The solution is now ready for the colorimetric determination of nitrates in the usual way with phenol disulphonic acid and ammonia.

There was no nitrate formation by the action of the permanganate on the organic matter.

Change in Composition of Unground Cereals during Storage: SHERMAN LEAVITT and J. A. LECLERC.

Samples of corn, wheat, barley, oats and rye in the unground state were allowed to stand for two years. Every six months samples were drawn for grinding and analysis. The authors found a gradual change in all of the cereals taken. This change becomes more rapid if the samples are ground before aging. The most marked changes are in the content of total sugar, 70 per cent. alcohol soluble proteid, 5 per cent. K_2SO_4 soluble proteid and Stutzer water soluble proteid. Unground corn lost 60 per cent. of its total sugar in two years and its entire germinative power. There was also evidence of a rearrangement of the proteid molecules.

In general corn, barley and oats in the order given were found most subject to a change of sugar content producing a loss. Wheat showed an increase of sugar in two years.

Corn, barley, rye, wheat and oats in the order given show the greatest proteid change.

The Importance of Experience in the Interpretation of the Results of Chemical Analyses: H. H. HANSON.

Incompletely described methods of analysis, unusual variations in materials under investigation, skillful imitations of many important products, and the personal equation of the operator make necessary the most extreme care in interpreting results of chemical analyses. The importance of check determinations with known substances and of repeated trials of unfamiliar methods is illustrated by reference to work upon paris greens, the search for artificial color in various products and examination of maple syrups and sugars and various kinds of vinegars. Unusual variations in the latter are cited and the importance of physical tests emphasized.

Lead Test in Cider Vinegar Analysis: F. A. NORTON.

Attention is called to the varying emphasis given to the lead test in cider vinegar analysis and the reagents employed. The test is shown to be of particular value in the case of a turbidity only being produced on the addition of neutral lead acetate to the vinegar being examined. The turbidity together with failure of the vinegar to give a copious precipitate is due to the presence of the normally insoluble pectinous constituents of the apple marc due to heating either through fermentation or steaming of second pressings or through the employment of badly fermented and heated apples for the manufacture of the vinegar. Increase in the right-handed polarization and of reducing sugars on inversion gives confirmatory evidence as to the presence of second pressings or employment of badly fermented stock. The neutral lead acetate is shown to be more delicate in its reaction than lead subacetate for the lead test, while the addition of alcohol, which is sometimes advocated, is not permissible as alcohol readily precipitates the pectinous bodies causing the turbidity, thus destroying the value of the test.

Normal Occurrence of Boric Acid in Virginia Peanuts: F. A. Norton.

Reference is made to previous work showing the presence of traces of boric acid in apples, pears, quinces, grapes, pomegranates, peaches, gooseberries, cherries, oranges and lemons. Also in hops, radishes, lettuce, carrots and sugar beets, the maximum amount of boric acid normally occurring which has been reported being .016 per cent. Reference is then made to work at the National Canners' Laboratory, showing the normal occurrence of boric acid in two lots of Virginia peanuts, the amount being .015 per cent.

To Determine Fat in Sweetened Condensed Milk: C. E. Cochran.

Weigh out 25 grams of the sample, dissolve in water and make up to 100 c.c. Transfer 6 c.c. to a double-tube milk flask provided with a small-bore tube graduated to give percentage of fat for 5 c.c. milk. Add 4 c.c. of ether and 4 c.c. acetic acid (80 per cent. or more absolute acetic acid). Acetic acid of this strength will dissolve the curd, but has no effect on the sugar. Place the flask in a vessel of warm water and heat until the ether is expelled. A layer of milk fat will now be seen floating on the surface of a clear and colorless liquid. Fill the flask with hot water, thus raising the fat into the graduated tube. The percentage of fat can now be read, the sample whirled in a centrifugal machine and another reading made. Multiply the reading by four.

The Anti-putrescent Effects of Copper Salts: Alfred Springer.

The peculiar behavior of the "certified and inspected milk" from the largest dairy impressed some of the chemists of this city with the belief that some antiseptic had been added to cause this milk to remain sweet. The milk commissioners and owners of the dairy in question indignantly denied that such was the case. After a long series of tests I found small quantities of copper salts present in all the bottles of certified and inspected milk coming from this dairy; furthermore, traced its presence largely to a boiler compound used, containing copper salts, which primed over in the sterilizing room. The milk is especially abnormal in never becoming putrescent, and showing, when exposed to the atmosphere peculiar growths of molds, which are described in the paper.

Experiments to show the anti-putrescent effects of copper salts with meat, egg and blood albumin, sewage and other substances are also described.

The Composition of the Oregon Hop: C. E. Bradley.

A study of typical hop plants with respect to their requirements of the soil gives values for phosphoric acid similar to those reported by Wolff. Nitrogen and potash are, however, less by one half in Oregon samples. Choice fresh hops yield .48 per cent. of oil by steam distillation. The resin content of sixteen commercially graded samples is reported, choice grades giving from 12.32 to 13.75 per cent. soft resin and from 5.35 to 6.59 per cent. hard resin.

The Effect of Low Temperatures upon B. coli and B. typhosus in Sterilized, Artificially Infected Milk: Geo. W. Stiles, Jr.

This investigation involves a bacteriological study of sterilized market milk artificially infected with pure cultures of *B. coli* and *B. typhosus*. Ninety small Erlenmeyer flasks containing 50 c.c. each of the infected milk were placed at ordinary ice-box (53°–63° F.), chilling (30°–34° F.) and cold-storage (—5°–8° F.) temperatures.

At intervals of three to four days one flask from each lot was removed and the number of colonies determined by plating on plain agar, being incubated four days at 25°–27° C. The initial bacterial content having been determined, the change in numbers varying from this standard are represented diagrammatically.

At ordinary ice-box temperatures the number of organisms, both *B. coli* and *B. typhosus*, multiply

quite rapidly from a few thousand to many millions. Milk infected with *B. coli* did not coagulate within thirty days, except by heating, which was first observed nine days after infection with a bacterial count of 1,000,000,000 per cubic centimeter and acidity of 4 per cent.

Since the investigations are yet incomplete, further conclusions are not deemed advisable at this time.

Abstracts were not received for the following papers:

The Quantity of Copper absorbed in the Process of Greening Vegetables and the Effect thereof on Digestibility: H. W. WILEY and HERMAN SCHREIBER.

The Composition of Concord, Catawba and Scuppernong Grape Juices: H. C. GORE.

A Simple Rapid-process Vinegar Generator for Experimental Purposes: H. C. GORE.

Some Reactions of Coal-tar Colors: C. B. COCHRAN.

Copper Compounds with Protein and their Relative Digestibility: H. W. WILEY and H. SCHREIBER.

Prairie Soil of Unusual Composition: F. J. ALWAY.

The Determination of Essential Oil and Alcohol in Flavoring Extracts: JULIUS HORTVET and RODNEY MOTT WEST.

The Fruit of Medeola Virginica: NICHOLAS KNIGHT and LOIS E. POYNEER.

BIOLOGICAL CHEMISTRY SECTION

J. J. Abel, chairman

Enzymes of Some Lower Fungi: ARTHUR W. DOX.

The enzymes were prepared by growing pure cultures of the molds on a protein-free medium and dehydrating the mycelium by Albert and Buchner's method for "Acetondauerhefe." The *Penicillium* of Camembert cheese was used principally. It was found to contain a protease which digests casein, gelatine and Witte-peptone, but which is without action on ovalbumin, vitellin, fibrin, elastin, edestin and excelsin. Its greatest activity is at the neutral point of methyl orange. It resembles Cohnheim's erepsin and Ascoli's "glutinase." A hippuric acid splitting enzyme was also found which yielded 64 per cent. of the theoretical amount of benzoic acid in twenty-four hours. Two green molds, *Penicillium chrysogenum* Thom and *Penicillium Roqueforti* Thom, both of which answer to Link's description of *Penicillium glaucum,* yielded in the one case 83 per cent. hydrolysis with sodium hippurate and in the other case no hydrolysis at all. Attention is, therefore, called to the necessity of using definitely identified organisms to make chemical experiments of any value. The numerous carbohydrate-splitting enzymes found in fungi by previous investigators were due in part at least to a breaking down of glycogen contained in the mold extract.

Some of the Fermentative Properties of Bacteria: D. H. BERGEY, M.D.

In a previous paper[1] I reported on a number of bacteria studied by myself and Dr. Deehan with regard to the fermentation of saccharose, dulcite, adonite and inulin. These carbohydrates were employed because the work of MacConkey indicated that they were of primary importance in the differentiation of bacteria belonging to the *colon ærogenes* group. Subsequent study with regard to the fermentative properties of these bacteria on other carbohydrates demonstrated that an organism without fermentative properties for these four carbohydrates might still not compare with others of similar properties with regard to other carbohydrates. Detailed study has shown that lactose, sorbose, raffinose and dextrin are also of primary importance in the differentiation of this group of bacteria.

I have attempted to ascertain some law concerning the fermentative properties of these bacteria to assist in explaining why one carbohydrate should be acted upon by a particular organism and another carbohydrate of related structure left intact. According to the teaching of Fischer and others, ferments can break up only those carbohydrates that have one or more asymmetrical groups, and in the light of Fischer's teaching the ferment must correspond in configuration to the carbohydrate on which it is acting, in a way similar to the relation of a key to the lock which it opens. We must conceive then that the ferment must likewise possess one or more asymmetrical groups so as to correspond to the configuration of the carbohydrate, or to be enabled to link on to the carbohydrate molecule to form a new chemical combination.

My studies have failed to disclose any constant relation between the carbohydrates fermented by closely related bacteria, and hence no law by which one could foretell what action a certain microorganism might have on the different carbohydrates.

Abstracts have not been received for the following papers:

[1] *Journal of Medical Research,* Vol. XIX., p. 175.

The Indirect Colorimetric Estimation of Small Amounts of P_2O_5 with Uranium Acetate and Potassium Ferrocyanide: R. B. Gibson.

Factors which Influence the Determination of Kreatinin: F. C. Cook.

On the Oxidation of Carbon Monoxide: J. H. Kastle.

The Relations of Magnesium and Phosphorus to Growth in the Fungi: Howard S. Reed.

Is Platinum Black Capable of Effecting the Hydrolysis of Ethyl Butyrate? A. S. Loevenhart.

The Absorption and Partial Purification of Catalase from Liver: A. W. Peters and H. W. Stewart.

The Diastatic Enzyme of Ripening Meat: A. W. Peters and H. A. Mattill.

The Influence of the Isomers of Salicylic Acid on Metabolism: E. W. Rockwood.

Surface Tension as a Factor in the Distribution of Salts in Animal and Vegetable Cells: A. B. Macallum.

Esterification of the Bile Acids: Isaac King Phelps.

Estimation of Total Sulphur: Isaac King Phelps.

A Study of Nylander's Reaction: M. E. Rehfuss and P. B. Hawk.

The Determination of Iodine in Protein Combinations: L. W. Riggs (by invitation).

A Distributing Factor in Barfœd's Test: William H. Welker.

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

A. D. Little, chairman

The Munroe Crucible: Walter O. Snelling.

The use of platinum felt as the filtering medium in a crucible of the Gooch pattern was first suggested by Professor Charles E. Munroe, in an article entitled "Filtration with Filters of Metallic Felt" published in the *Journal of Analytical Chemistry*, Vol. 2, part 3, July, 1888.

Crucibles prepared by the method suggested by Professor Munroe have many advantages not possessed by any other type of apparatus used for filtration. These filters retain the finest precipitates, and owing to the fact that no other material than platinum enters into the construction of the filter, no impurity other than this metal can contaminate the filtrate, and thus in very exact work a very great advantage is gained through the use of the Munroe crucible.

A series of tests were described, showing that the porosity of the mat of the Munroe crucible was many times greater than that of the asbestos mat in crucibles of the usual type. The preparation of the crucible was described, and a number of experiments were mentioned showing the wide range of applications for which the crucible was suited, and the many classes of work in which it has been found to be superior to other types of filtering apparatus.

The Rapid Determination of Moisture in Commercial Products of a Viscous or Semi-solid Consistency: Arthur Lowenstein.

The author states that "the method employed consists merely in the application of several well-known principles, viz., the addition of a dehydrating agent of a lower boiling point than water, in which the material to be desiccated is wholly or in part soluble, or at least miscible. The reagent employed is ordinary 95 per cent. ethyl alcohol. In the case of materials containing soluble proteins, the alcohol acts in some cases as a coagulant, and in others as a precipitant, which action facilitates the drying process. A definite quantity of the material is weighed into a metal dish, 2½ inches in diameter, together with a short glass stirring rod, 15 c.c. of alcohol added; stirred thoroughly; evaporated on steam bath; another portion of alcohol added and similarly evaporated. Dish then transferred to jacketed oven at 105° C. and dried to constant weight. Total period of drying, 1½–2½ hours. Table gives results of tests on meat extracts, concentrated glue solutions, concentrated tank water, inspissated ox gall, dyewood extracts, syrups, various kinds of cheese, etc.

An Unusual Incrustation on Generator Coils: E. H. Ehrenfeld.

On the generator coils of a refrigeration plant of the absorption type there was formed a hard, semi-crystalline scale about one sixteenth of an inch thick. Its texture was very compact, its density 5.117, and on being tapped it gave almost a metallic sound.

It was formed on the outside of two-inch iron pipes through which steam circulated. The pipes were surrounded by strong aqua ammonia, and it was from this ammonia that the scale was deposited. A part of the circulation system having been constructed of galvanized iron, zinc was taken up by the ammonia and the scale deposited therefrom contained over 90 per cent. of zinc oxide.

Abstracts have not been received for the following papers:

Rapid Analysis of Babbitt Metal: Percy H. Walker and H. A. Whitman.

The Unsaponifiable Matter in the Oleo-resins of Conifers: CHAS. H. HERTY and W. S. DICKSON.

Acceleration Tests of the Resistance to Corrosion of Iron and Steel: ALLERTON S. CUSHMAN.

The Changes in Crude Petroleum Effected by Diffusion through Clay: DAVID W. DAY.

Further Remarks on Vanadium and its Estimation: GEORGE AUCHY.

Iron, from a Chemical and Commercial Standpoint: PAUL N. CLANCY.

An Unusual Incrustation on Generator Coils: C. H. EHRENFELD.

Principles Underlying Efficient Grinding and Separating: W. H. WALKER.

The Purchase of Material on Specification: H. J. SKINNER.

Some Industrial Applications of the Ives Colorimeter: F. A. OLMSTEAD.

Factors determining the Efficiency of Trolley Wires: C. F. WOODS.

The Iodine Number and some other Values for China Wood Oil: E. W. BOUGHTON.

Accuracy in Sampling Coal: E. G. BAILEY.

The Storage of Beef at Temperatures above the Freezing Point: W. D. RICHARDSON.

Observations on the Freezing Out of Colloids with Reference to Frozen Meats: W. D. RICHARDSON.

Observations on Certain Stains applied to Frozen and Unfrozen Muscular Tissue: W. D. RICHARDSON.

Frozen Poultry: W. D. RICHARDSON.

Observations on the Best Methods of Cold Storage: W. D. RICHARDSON.

The Commercial Manufacture of Amorphous Calcium Phosphide: CHARLES E. MUNROE.

The Distribution of Nitrate of Soda in the United States: CHARLES E. MUNROE.

Standard Methods for Determining and Recording the Relative Permanency or Resistance of Coloring Matter to the Common Color Destroying Agencies: L. A. OLNEY.

Standardization of Methods for Commercial Analysis of Fats, Greases, etc., and Adoption of Rational Nomenclature for Same: A. G. STILLWELL.

Guayule and Guayule Rubber: THEODORE WHITTELSEY.

Lubrication and Lubricants: C. F. MABERY.

FERTILIZER CHEMISTRY SECTION

F. B. Carpenter, chairman

Some Points of Interest in Connection with Present Fertilizer Laws and Proposed Fertilizer Legislation: ARTHUR LOWENSTEIN.

The author first indicates the points which are at present uniform in the various state fertilizer laws. He next points out in detail the lack of uniformity in these laws, and states that this is due not so much to lack of uniformity in the basic principles of the laws, but rather in the elaboration of the principles, and the mode of expression of the details. Quotations are made from the 1907 report of the Committee on Fertilizer Legislation of the A. O. A. C., in which this committee favors national fertilizer legislation, after certain specified difficulties have been overcome. The point next discussed is, if a national law were enacted, whether it would bring about the harmony and uniformity desired or not. The author points out why, in his opinion, it would not. He proposes a uniform state fertilizer law and recommends that a committee be selected by the Division of Fertilizer Chemists of the American Chemical Society to confer with similar committees from the A. O. A. C., National Fertilizer Association and the Association of Agricultural Colleges and Experiment Stations, with a view to drafting a uniform state fertilizer bill—all parties concerned being represented on this joint committee. Then if a national law is desired or necessary for the control of interstate commerce, work for the adoption and passage by congress of this uniform law.

Potash Experiments in Factory Work showing Heavy Loss by Official Method and Possible Means of Preventing this Loss: J. E. BRECKENRIDGE.

A brief history of the work of the Association of Official Agricultural Chemists on potash during recent years, showing loss of potash by official method.

Methods used to find this lost potash explained with results on thirteen samples. Some methods used:

No. 3. (*a*) Same as Carpenter method, except 1 per cent. citric acid solution was used for solvent instead of 5 c.c. HCl in 300 c.c. water.

No. 11. Washed 2 grams on 11 cm. filter with small portion of hot water into a 200 c.c. flask to about 175 c.c., when no chlorid or soluble sulphate should be left in residue on filter. Add .6 gram citric acid to flask, heat contents of flask to boiling, add ammonia and ammonium oxalate and proceed as in official method.

No. 12. Same as No. 11, only use 3 c.c. HCl in place of .6 gram citric acid.

No. 13. Same as No. 11, only do not add any citric acid.

Abstracts have not been received for the following papers:

The Fertilizer Industry—An Historical Sketch: F. B. Carpenter.

A Comparison of Various Methods in bringing about the Solution of Potash in Mixed Fertilizers and Tobacco Stems: M. H. Pingree.

A Discussion of Methods for Determining the Availability of Phosphoric Acid in Thomas Phosphate Powder: Geo. D. Leavens.

A Discussion of Methods for the Determination of Iron and Alumina in Phosphate Rock: F. P. Veitch.

Note on the Determination of Insoluble Phosphoric Acid: F. B. Carpenter.

Chemistry and Geology of the Inland Phosphates of the United States: Lucius P. Brown.

Loss of Potash in Commercial Fertilizers: F. B. Porter.

Remarks on the Gladding Method for Phosphoric Acid (weighing direct the phospho-molybdate precipitate): A. G. Stillwell.

PHARMACEUTICAL CHEMISTRY SECTION

Edward Kremers, chairman

Determination of Acetanilid in Hydrogen Peroxide Solutions: Elwyn Waller.

In a side neck flask of 200 c.c. capacity, place about half a stick of caustic potash or soda (6 to 7 grams). Add about 20 c.c. of water to dissolve, and then 25 to 30 grams of granulated metallic zinc. Then add a measured amount, not over 50 c.c. of the solution to be tested. Connect the flask on the one side with a flask to supply steam, arranging the tube to deliver steam near the bottom of the solution; connect on the other side with a condenser. The condenser should deliver into a Peligot bulb tube or some other arrangement by which the distillate is immediately brought in contact with moderately strong hydrochloric acid.

Raise the heat on the flask slowly, and when nearly half of the contents have distilled over, start the steam to passing through. The end of the distillation is a matter of guess. When the anilin is coming over in quantity, fumes are to be seen in the receiver, but for the last portions they can not be seen. When it is judged that all has come over, detach the receiver and catch what comes over later in a fresh receiver or a beaker, and titrate it separately.

To prepare the volumetric bromine solution, dissolve 25 grams of caustic potash in 20 to 40 c.c. of water, cool, and add liquid bromine until it appears supersaturated. Then dilute to about 200 c.c. and boil out excess of bromine (judged by the color). Cool, and dilute to one liter. This should give a solution of which 1 c.c. = nearly 0.01 gm. acetanilid. Standardize by means of a solution containing 0.5 gm. acetanilid in 200 c.c. of water, using 30 to 50 c.c. lots at a time, treated either by distillation on the manner above given, or by boiling with strong hydrochloric acid. Either method was found to give the same result with the same amount of acetanilid.

The method was tested by first distilling known quantities of the sample and titrating the distillate, then adding known amounts of acetanilid to the same quantities of the sample, and distilling. The distillates took just the additional amount required by the acetanilid added.

The presence of acetanilid was indicated by obtaining the isonitril reaction on the original sample.

Recent Developments in Preparations for Administering Sulphur: Elwyn Waller.

This paper discusses the reasons why attempts are being made to obtain sulphur in an unoxidized but soluble condition. The therapeutic effects of sulphur seem to be inversely proportional to the degree of oxidation.

Sulphur in solid form does not lend itself readily to absorption. The ordinary solvents of sulphur have therapeutic effects of their own and are not desirable for use.

Lac sulphuris leaves much to be desired. These facts have caused the appearance of preparations of colloidal sulphur. It is claimed these are the equal of lac sulphuris and are soluble in water.

Analysis of two such preparations are as follows (results were in grams per 100 c.c.):

Total sulphur	3.05
Lime	1.51
Residue on evaporation	4.94

Lime appeared to be the only base, and no sulphate was present, the sulphur was probably present as in the lac sulphuris.

A second sample soluble in water contained sulphur probably as sodium sulphite. This sample contained resin probably as solvent for the sulphur. The presence of hydrogen sulphide could not be established in either sample.

Abstracts have not been received for the following papers:

The U. S. P. Method for Making Precipitated Sulphur: Edward Kremers.

The U. S. P. Test for Petroleum in Turpentine Oil, and the New Process Oils: Edward Kremers.

A New Method for Alkaloidal Determinations with Mercuric Potassium Iodide: G. HEIKEL.

INORGANIC CHEMISTRY SECTION

Charles H. Herty, chairman

Denudation in the United States: R. B. DOLE and H. STABLER.

This paper presents computations of the rate at which the earth's crust is being moved as solid particles carried in suspension by streams and as matter carried in aqueous solution. The computations are based on twenty years' stream gauging work at 1,500 stations and about 5,000 water analyses by the Water Resources Branch of the U. S. Geological Survey, supplemented by stream gauging data of the Engineer Corps, U. S. A., and the Weather Bureau and by some miscellaneous analyses from state and municipal reports. Except the estimates for the Northern Pacific, Great Basin and Hudson Bay areas, for which the data are rather meager, the figures are believed to be within twenty per cent. of the correct average values. Estimates for over one hundred secondary drainage basins were computed.

If denudation in the Great Basin is taken as zero, the figures for the entire United States are as follows: Tons of solids removed per square mile per year, dissolved, 87; suspended, 166; amounting to a total of 270 million tons of dissolved and 513 million tons of suspended matter per year; equivalent to 1,330 millionths of an inch per year, or one inch in 760 years.

A Spectroscopic Method for Determining Small Amounts of Lithium: W. W. SKINNER.

The separation and determination of lithium, when present in very small amounts, or when the ratio of sodium and potassium to lithium is high, are accomplished with very considerable difficulty. This method proposes the use of the spectroscope under definite conditions for this purpose, the idea being that the brilliancy and length of duration of the lithium spectrum are, within certain limits, proportional to the quantity of material introduced into the flame.

Classification of the Elements for Arranging References to Articles: A. L. VOEGE, Concilium Bibliographicum, Zurich, Switzerland. (Presented by W. C. Bray, Massachusetts Institute of Technology, Boston.)

Mr. Voege has been engaged for a number of years in adapting the Dewey system of classification to the subject of electro-chemistry. He desires to use a classification of the chemical elements that will be satisfactory to chemists, and is anxious to receive expressions of opinion from the American Chemical Society and its individual members on the four different classifications which he has prepared. In two of these the elements are separated into metalloids and metals; in the other two the ordinary periodic system, and the Werner periodic system, respectively, are followed. After considerable discussion, the matter was referred to the council of the society. Circulars describing the different arrangements, which arrived too late for distribution at the meeting, may be obtained from Mr. Bray.

Abstracts were not received for the following papers:

Preliminary Note on a New Volumetric Method for the Determination of Cerium in the Presence of other Rare Earths: F. J. METZGER.

Standards of Volumetric Analysis: LAUNCELOT W. ANDREWS.

The Iodometric Determination of Sulphates and that of Sulphur in Coal or in Organic Compounds: LAUNCELOT W. ANDREWS.

The Supposed Presence of Iodate in Commercial Potassium Iodide—an Illusion: LAUNCELOT W. ANDREWS.

Erbium and its Companions (preliminary paper): CHARLES JAMES.

The Transformation of other Forms of Carbon into Graphite: WILLIAM C. ARSEM.

Electrolytic Estimation of Lead, using the Mercury Cathode: M. HUME BEDFORD.

A Method for the Preparation of Standard Hydrochloric Acid: G. A. HULETT and W. B. BANNER.

The Atomic Weight of Lithium: THEODORE W. RICHARDS and HOBART H. WILLARD.

The Basic Nitrates of Magnesium: CHARLES L. PARSONS and GEO. A. PERLEY.

Barium Sulphate in Analysis in the Munroe Crucible: ISAAC KING PHELPS.

The Weight of Carbon Dioxide with a Table of Calculated Values: S. W. PARR.

Ferric Nitrates in Aqueous Solutions: F. K. CAMERON and W. O. ROBINSON.

Review Phosphate Situation: F. K. CAMERON and J. M. BELL.

ORGANIC CHEMISTRY SECTION

S. F. Acree, chairman

Preparation of Benzophenone: J. BISHOP TINGLE and W. W. HOLLAND.

It is well known that the interaction of gases at moderately high temperatures is largely influenced by apparently small variations in the physical state of the containing vessel. These effects

are usually described as "catalytic," but it is obviously very difficult in many cases to distinguish between a "catalytic" influence and one due only to an alteration in the thermal properties of the surface of the container. In the hope of throwing some light on the subject we have investigated the production of benzophenone by the distillation of calcium benzoate in a current of carbon dioxide. The calcium salt was mixed intimately with the substances mentioned below, the figures give the percentage yield of benzophenone. Unglazed porcelain, 30.4; carbon from arc light rods, 40.9; iron filings, 45.0; calcium carbonate and iron filings, 54.5; calcium carbonate and arc light rods, 50.0. These results are the mean of closely agreeing duplicates and express the yield percentage of the theoretical. The yield of benzophenone from benzene, aluminium chloride and benzoyl chloride is 42.8 per cent., according to Gattermann.

Studies in Nitration—VI., Synthesis of Certain Nitranilides: J. Bishop Tingle and C. E. Burke.

Work is in active progress on the synthesis of a number of nitrophenylamides, nitrophenylimides and nitrophenylamidic acids from *o*-, *m*- and *p*-nitraniline. In this manner it is hoped to identify some of the many compounds prepared by the senior author and Dr. F. C. Blanck by the nitration of the corresponding aniline derivatives. A description of the individual compounds thus far synthesized will appear in due course.

Aniline Derivatives of Certain Unsaturated Dibasic Acids of the Aliphatic Series: J. Bishop Tingle and S. J. Bates.

It has been shown by the senior author and his collaborators that succinanilic acid, $C_6H_5NHCOCH_2CH_2CO_2H$, when treated with aniline yields succindianilide, $C_6H_5NHCOCH_2CH_2CONHC_6H_5$, whereas phthalanilic acid, $C_6H_5NHCOC_6H_4CO_2H$, under similar conditions is converted into the anil,

$$C_6H_4\begin{<}\begin{matrix}CO\\CO\end{matrix}\end{>}NC_6H_5.$$

The investigation has now been extended to the aniline derivatives of maleic, fumaric and malic acids. Several new compounds have been prepared. A study is being made of the action of various amines on fumar-, male- and malanilic acids,

$$\begin{matrix}HCCO_2H\\ \vdots\\ C_6H_5NHCOCH\end{matrix} \quad , \quad \begin{matrix}HCCO_2H\\ \vdots\\ HCCONHC_6H_5\end{matrix}$$

and $C_6H_5NHCOCH(OH)CH_2CO_2H$, respectively.

Rearrangement in the Phthalamidic Acid Series—IV.: J. Bishop Tingle and B. F. Parlett Brenton.

The work of Bishop Tingle and his collaborators on this subject has been extended. Phthaldiphenylamidic acid, $(C_6H_5)_2NCOC_6H_4CO_2H$, when heated with pyridine at 100° gives *dipyridinium phthalate*, in 109°. Aniline transforms the acid into phthalanil,

$$C_6H_4\begin{<}\begin{matrix}CO\\CO\end{matrix}\end{>}NC_6H_5,$$

whereas by the action of β-naphthylamine a mixture of phthalanil and phthal-β-naphthylamidic acid, $C_{10}H_7NHCOC_6H_4CO_2H$, is obtained. The following new acids have been prepared by the method described recently by Bishop Tingle and Rolker.[1] A study is being made of the action on them of various amines. *Phthalphenyl-β-naphthylamidic acid*, $C_6H_6N(C_{10}H_7)COC_6H_4CO_2H$, m. 115°. *Phthal-p-chlorphenylamidic acid*, $ClC_6H_4NHCOC_6H_4CO_2H$, m. 180°. *Phthaldiisobutylamidic acid*, $[(CH_3)_2CHCH_2]_2NCOC_6H_4CO_2H$, m. 153°. The product from diisoamylamine was tarry. Ethylaniline and methylaniline yielded the diamides $C_6H_4[CON(C_6H_5)C_2H_5]_2$ and $C_6H_4[CON(C_6H_5)CH_3]_2$, respectively, m. 144° and 181.5°. Two compounds have been prepared from benzidine and phthalic anhydride, both melt only at high temperatures. One appears to be the diamide or imide,

$$C_6H_4\begin{<}\begin{matrix}CO\cdot NH\cdot C_6H_4\\CO\cdot NH\cdot C_6H_4\end{matrix}\end{>},$$

or

$$C_6H_4\begin{<}\begin{matrix}CO\\CO\end{matrix}\end{>}NC_6H_4\cdot C_6H_4NH_2.$$

The other has not yet been investigated. *p*-aminobenzoic acid gives the *dibasic acid*, $HO_2CC_6H_4CONHC_6H_4CO_2H$, m. 271°.

The action of carbamide and its substitution products on phthalic anhydride has been made. It is found to take place according to the equation,

$$\begin{matrix}CO\\CO\end{matrix}C_6H_4\begin{<}\diamond\end{>}O + RHNCONH_2$$

$$\rightarrow C_6H_4\begin{<}\begin{matrix}CO\\CO\end{matrix}\end{>}NR + NH_3 + CO_2.$$

The compounds produced when R = H, C_6H_5, $C_6H_5CH_2$, CH_3 and C_2H_5 have been investigated. Phenythiocarbamide behaves in a similar manner, NH_3 and COS being evolved. Ethylidenecarbamide

[1] *Jour. Am. Chem. Soc.*, **30**, 1882, 1908.

gives a tar. Form-β-naphthylide and phthalic anhydride yield formic acid and phthal-β-naphthylimide.

The Synthesis of Orthohydroxyazobenzene: WM. MCPHERSON and H. J. LUCAS.

The synthesis of orthohydroxyazobenzene by the saponification of the compound obtained by the action of unsymmetrical benzoyl phenylhydrazine on orthobenzoquinone was described. The bearings of this synthesis on the constitution of the orthohydroxozo compounds was also discussed.

Occurrence of Diterpenes in Camphor Oil: ALFRED HOFFMAN.

The so-called "blue, thickened" camphor oil of commerce, which consists of the highest boiling parts of camphor oil, contains in its highest fraction a few per cent. of a hydrocarbon $C_{20}H_{32}$. Purified by distillation over metallic sodium, it is a colorless, mobile liquid of faint odor and the following physical properties: b. 20 mm. = 195–205°, b. 760 mm. = 315–320° with slight decomposition, $\alpha_D = +6°\,49'$, $d\,24° = 0.902$, $n_D = 1.5024$, molecular refraction for $C_{20}H_{32}$ with three double bonds, found 88.94, calculated 88.77. This would point to its being bicyclic. It does not resinify on standing, can be distilled with steam and is unsaturated toward potassium permanganate and bromine, adding about six atoms of the latter. This seems to be the first instance of a hydrocarbon with such a high boiling-point being found in a natural essential oil.

The Condensation of Acetone with Calcium Oxide: ALFRED HOFFMAN.

The formation of mesityl-oxyd, isophoron and the xylitons from acetone under the influence of calcium oxide has been studied by a number of chemists and the constitution of the products established. The present article deals with the mechanism of the reaction. Briefly, it was found that the simplest condensation product, mesityl-oxyd, was formed first, and from it alone or with acetone the more complicated ones. It was also shown that the first step in the reaction in all cases is an aldol condensation under the influence of the small quantities of calcium hydroxide usually present as impurity. Then water is split off to form the known condensation product. Thus, with perfectly pure calcium oxyd no condensation takes place, even on heating under pressure. In the simplest case, that of acetone to mesityl-oxide, the intermediate product could be isolated and was shown to be the alcohol diacetone which has already been described as a product of the action of alkalies on acetone.

5-Brom-2-Aminobenzoic Acid: ALVIN S. WHEELER.

Trichlorethylidene-o-aminobenzoic acid on bromination in glacial acetic acid gives a high yield of 5-brom-2-aminobenzoic acid which is converted into the free base by water. Direct bromination of anthranilic acid under like conditions gives a less pure product. A detailed comparison of the two methods will soon be compieted.

Fixation of Labile Hydrogen Atoms by Chloral: ALVIN S. WHEELER and STROWD JORDAN.

The condensation of chloral with primary aromatic amines gives compounds of the type $CCl_3CH(NHPh)_2$. Substituted amines may be used, but these are limited to those containing not more than two negative elements or groups in the benzene nucleus. All such compounds on bromination split off chloral and give brominated amines. A quantitative study is being made, comparing this method with the direct bromination of amines. The reactions proceed best in glacial acetic acid.

The Anhydride of Chlorterephthalic Acid: JOHN E. BUCHER.

This acid easily forms an anhydride $(C_8H_3ClO_3)_x$ on treatment with acetic anhydride. Molecular weight determinations indicate that the value of x is very high.

The Oxidation of 1-Phenylnaphthalene Derivatives to Benzenepentacarboxylic Acid: JOHN E. BUCHER.

A number of anhydrides obtained by the action of acetic anhydride on phenylpropiolic acid were oxidized to benzenepentacarboxylic acid. This reaction shows that they are derivatives of 1-phenylnaphthalenedicarboxylic anhydride. In the final oxidation which was carried on in fuming nitric acid, it was necessary to use manganese nitrate as a catalytic agent.

Abstracts have not been received for the following papers:

Studies in Catalysis: S. F. ACREE.

Studies in Tautomerism: S. F. ACREE.

The Alkylation of Tautometric Acids: SIDNEY NIEDLINGER.

The Catalytic Formation of Esters from Amides and Alcohols in the Presence of Acids: E. E. REID.

The Catalytic Hydrolysis of Amides by Acids and Alkalies: E. E. REID.

On the Determination of Halogens in Organic Compounds: C. W. BACON.

Rearrangements in the Camphor Series: Isocampholactone: W. A. NOYES and A. W. HOMBERGER.

The Addition of Acetic Acid to Unsaturated Hydrocarbons: Edward Kremers.

The Esterification Law and Steric Hindrance Hypothesis: M. A. Rosanoff and W. L. Parger.

A New Method for Detecting Mutarotation: C. S. Hudson.

Alkylation of Cyanacetic Ether: John C. Hessler.

The Theory of Indicators and the Reactions of Phthaleins and their Salts: E. A. Slagle.

The Mechanism of Oxime Formation and Hydrolysis: L. Junius Desha.

The Determination of Acid Radicals in Esters of Cellulose: R. G. Woodbridge, Jr., and F. J. Moore.

The Condensation of Nitromalonic Aldehyde with Urea: William J. Hale.

Some New Terpine Derivations: Geo. B. Frankforter.

The γ-γ'Diketonic Acids: J. B. Garner.

Further Studies in Catalysis in Ester Formation: Isaac King Phelps.

Removal of Plant Food from Soil by Plants: F. K. Cameron and J. G. Smith.

PHYSICAL CHEMISTRY SECTION

Gilbert N. Lewis, chairman

The Behavior of the Nickel Anode: E. P. Schoch.

Starting at the equilibrium potential of nickel in neutral nickel sulphate solution, and polarizing anodically with gradually increasing current densities, the author found that nickel showed what may be called "normal" anodic behavior with very small current densities, but that with larger current densities the active surface appears to be diminished. This diminution of the active surface is due to the discharge of oxygen; and the whole behavior of the nickel anode with large current densities is due to the relation of the areas of the active to the impaired spots. This presents the phenomenon of porosity in a new light.

The Temperature Coefficient of the Conductivity at Infinite Dilution: John Johnston.

Value of Λ_0 at a series of temperatures ranging between 0° and 156° were obtained for a number of salts by extrapolating with the aid of the function $1/\Lambda = 1/\Lambda_0 + K(C\Lambda)^n$, values of n being chosen so that the graphs were nearly linear. From these were derived values of l, the mobilities of the separate ions. On plotting the values of log l at the various temperatures against the logarithms of the numerical values of the fluidity of water at the corresponding temperatures, straight lines were obtained for all the ions investigated, with the exception of H^+ and OH^-, where, indeed, abnormality might be expected, as these two ions occupy a quite especial position when water is the solvent. For the others (thirteen in number, including uni-, di-, tri- and quadrivalent ions), the derivations from linearity are not greater than the error of the separate determinations. Thus this method presents a very convenient means of obtaining the value of l at any intermediate temperature, or of calculating its temperature coefficient, since the temperature coefficient of the fluidity of water is known and may be expressed by a fairly simple formula.

The Change in Refractive Index with Temperature —I.: K. George Falk.

The refractive indices for the three hydrogen and the sodium lines and the density of diisoamyl, *n*-heptyl alcohol, benzyl alcohol, dimethylaniline, *n*-butyric acid and acetylacetone were determined at a large number of temperatures between 20° and 70°. The variation was found to be a straight line function of the temperature for all. The change in the refractive powers, using the expressions $n^2 - 1/d$, $n - 1/d$, $n^2 - 1/(n^2+2)d$, were also calculated. Ethyl acetate gave results indicating a change in the equilibrium between the tautomeric forms at higher temperatures.

A Modified Oxyhydrogen Gas Coulometer: J. W. Turrentine.

The Walter-Neumann, single tube, oxyhydrogen gas coulometer, with adjustable leveling tube, has been modified, so that the platinum electrodes, in the old form fastened to a short length of platinum wire which was sealed in the glass walls of the coulometer and terminated on the outside in a small loop, are sealed in glass tubes and are inserted into the coulometer through rubber stoppers held in side arms.

Objectionable features of old form: (1) Electrical connection was made with coulometer by hooking wires in the loops. This gave poor contact and high local resistance and (2) consequent heating which caused alternate expansion and contraction, and soon resulted in the cracking of the glass and the breaking out of the electrodes, (3) or the platinum loops soon broke off. (4) In either case the apparatus became useless and the platinum electrodes had to be discarded.

Advantages claimed for the modified form: (1) Electrodes are adjustable and (2) may be removed and cleaned. (3) Due to the elimination of the fragile seal in the wall of the main tube, the apparatus is more durable. (4) In case of breakage, the platinum parts are not "scrapped," but are transferred to a new tube. This requires the

purchase in such a case of glass parts only. (5) Electrical connection is made through a length of copper wire. Good contact may then be got by means of screw connectors.

The Rapid Precipitation of Metals on Gauze Cathodes with Fixed Electrodes: JOHN T. STODDARD.

Cadmium, copper, nickel, silver, zinc and probably other metals may be quantitatively precipitated for their solutions upon a fixed gauze cathode, with a fixed anode in about the same time as that required when rotating electrodes are employed. The current used is about the same as in the latter method.

The cylindrical cathode, 3 cm. in diameter and 3 cm. high, is made of platinum gauze, described by the maker as 52-mesh and made of 0.004 inch wire. Its total surface is calculated to be about 40 sq. cm. The anode is a cylinder of platinum foil, about 2.5 cm. high and of a diameter which may vary between 0.5 and 1.2 cm.

It is placed concentrically within the gauze cathode. The electrolysis is carried out in a 80 c.c. beaker with about 50 c.c. of solution, in order to gain the advantage of concentration. The current strength may vary within wide limits in most cases without influencing the character of the deposits, but the time is greatly shortened only when comparatively high currents are used.

It appears that the more or less troublesome and expensive arrangements for rotating one of the electrodes, or of agitating or rotating the solution by mechanical means or by the use of a magnetic field are quite unnecessary for rapid and complete precipitation.

The character of the deposited metals is excellent, and entirely satisfactory analyses have been made by the method described above.

The Rapid Precipitation of Metals in a Mercury Cathode with Fixed Anode: JOHN T. STODDARD.

Cadmium, copper, nickel, silver, zinc and probably other metals can be precipitated in a mercury cathode with a fixed anode in substantially the same time as that required with the use of a rotating anode. The anode is a flat spiral of platinum wire, and it is placed 1.05 cm. from and parallel to the surface of the mercury in a 50 c.c. beaker. The cathode connection is made by a platinum wire, which is protected from the solution by a small glass tube sealed to it 2–3 mm. from the end, which dips into the mercury.

The solution may have any volume from 10 c.c. to 30 c.c. The strength of current is limited only by the danger of loss from too violent boiling of the solution. About 40 g. of mercury are used as cathode.

The following table shows the time necessary for complete precipitation of the metals:

Metal	Approx. Amount	Current Strength	Time in Minutes
Cadmium	0.21 g.	5 Amp.	10
Copper	0.4	4	8
Nickel	0.2	6	12
Nickel	0.5	7	15
Silver	0.5	8	7
Zinc	0.4	6	15

Analyses made by this method give satisfactory results, concordant with those made from the same solutions with gauze cathode and fixed anode.

Some New Laboratory Apparatus: JOHN T. STODDARD.

1. The wire-test-tube holder, described by the writer in the *Journal of Analytical Chemistry*, January, 1890, is used as the clamp on a light stand. The clamp is adjustable at any angle and up to 10½ inches in height above the table. The support is well adapted to many services in the laboratory and has great stability from the special design of its base.

2. A funnel support which fits on the above stand consists of circular plate of aluminium with openings for the reception of four funnels. The special base of the stand insures stability for a much greater load than the funnels when full of solution. Its chief advantage is compactness.

3. A wire dish holder, which grasps an evaporating dish by the edge and holds it securely.

Abstracts have not been received for the following papers:

A New Method of Determining the Partial Vapor Pressures of Binary Mixtures: M. A. ROSANOFF and ARTHUR B. LAMB.

On the Partial Vapor Pressures of Binary Mixtures: M. A. ROSANOFF and C. W. EASLEY.

Recent Evidence for the Existence of Hydrates in Aqueous Solutions: H. C. JONES.

A New Law concerning the Vapor Pressures of Binary Mixtures: M. A. ROSANOFF.

On the Duhem-Margules Equation as applied to Binary and Ternary Mixtures: WILLIAM EDWARD STORY.

Preparation of Pure Hydrogen and the Elimination of Oxygen: GEO. A. HULETT.

A Maximum Volt Meter: W. LASH MILLER.

The Relations between Viscosity and Fluidity: EUGENE C. BINGHAM.

A New Method of Measuring Association by Means of Fluidity Data: Eugene C. Bingham.

A Simplification of the Cyclical Process Method for Deriving Thermodynamic Equations: E. W. Washburn.

Cuprous Hydroxide: W. D. Bancroft.

Osmotic Studies: L. Kahlenberg.

Crystallization through Membranes: J. H. Walton.

An Explanation of the Negative Coefficient of Expansion of Silver Iodide: Grinnell Jones.

The Significance of certain Numerical Relations in the Sugar Group: C. S. Hudson.

The Formation of Nitric Oxide by the Action of Nernst Glowers on Air: Irving Langmuir.

The Potential of the Sodium Electrode: G. N. Lewis and C. A. Kraus.

The Reaction Velocity of an Inorganic Hydrolysis: S. C. Lind.

The Solubility of Salts in Concentrated Acids: Arthur E. Hill and John L. Simmons.

Transition from Metallic to Electrolytic Conduction: C. A. Kraus.

A Dilution Law applicable to both Aqueous and Non-aqueous Solutions: C. A. Kraus.

Equilibrium in Solutions containing Copper and Iodine: W. C. Bray and G. M. J. Mackay.

The Properties of Water near the Critical Point: R. C. Mailey.

The Internal Heat of Vaporization: J. E. Mills.

The Molecular Masses of Liquids: G. H. Meeker.

Some Applications of the Phase Rule as a Means for Determining Water in Certain Organic Substances: S. W. Parr and F. W. Bliss.

Heat Conductance of Soils: H. E. Patten.

B. E. Curry,
New Hampshire College *Press Secretary*

Transmitted by C. H. Herty,
Secretary of Section C

SOCIETIES AND ACADEMIES

THE TORREY BOTANICAL CLUB

The meeting of December 8, 1908, was held at the American Museum of Natural History, President Rusby in the chair. About seventy-five persons were present. The announced scientific paper of the evening on "Mechanical Response of Plants" was then presented by Sir Jagadis Chunder Bose, professor in the Presidency College of Calcutta and author of "Response in the Living and Non-Living," "Plant Response as a Means of Physiological Investigation," etc. The presentation of the subject was accompanied by an exhibition of some of the ingenious and delicately contrived apparatus constructed by Professor Bose for the purpose of measuring and recording the responses of plants to various stimuli. Following is an abstract of the paper compiled from notes furnished by Professor Bose:

The effect of stimulus impinging on a responding tissue is to induce a fundamental molecular derangement. This condition of derangement constitutes excitation. On the cessation of stimulus, there is a slow recovery, the tissue returning to its original condition. This molecular reaction is itself beyond our scrutiny, but it may be shown that we can gauge its intensity and extent by the observation and record of certain concomitant changes induced by it in the responding tissue. Among these are (1) changes of form, manifested as mechanical response, and (2) changes of electrical condition, which may be recorded as electrical response.

The intensity of the responsive change will obviously depend on the two factors of strength of stimulus and physiological condition of the tissue. Hence, when stimulus is constant, the amplitude of response gives us a measure of the physiological condition. Now we know that the changing environment must induce unknown changes in this physiological condition, of which there is no outward sign. But we are here enabled to make the plant itself reveal its condition, by the reply it makes to the blow of a stimulus. A stimulating agent will exalt, and a depressing agent diminish or abolish, this response. We have thus a means of attacking the deeper problem of the physiological variation in an organism.

The speaker had been able to overcome the numerous difficulties which occur in connection with the automatic recording of the mechanical response of the plant, by devising three types of instrument. These are (1) the oscillating recorder, (2) the optical lever and (3) the balanced crescograph.

In the oscillating recorder, the recording lever is made of light aluminum wire and is suspended vertically on jewelled bearings. This lever is L-shaped, and the shorter arm, at right angles to the longer, is attached to the responding leaf. The great advantage conferred by the oscillating recorder lies in the fact that the friction of the writing point against the recording surface is practically eliminated. The source of friction in such arrangements arises from permanence of this contact. In this instrument, however, the writing lever is virtually free, except for the brief intervals in which the smoked glass surface is brought into periodic contact with it. For these records,

the glass surface moves in a vertical plane by means of clockwork, and a minute oscillation to and fro is given to it by the agency of an electromagnetic arrangement. The period of this oscillation is, say, one fifth of a second, and the record is thus made to consist of a series of dots, separated by time-intervals of one fifth of a second. Thus we can see the time-relations of the curve at a glance.

For responsive movements of minute leaflets the speaker employed the optical lever. By use of this a very high magnification is possible. The record is made on a traveling photographic plate by the spot of light reflected from the optical lever, connected with the responding plant.

For the instant detection of the effect of stimulus on the rate of growth, the balanced crescograph is used. Here a balanced and stationary point of light undergoes a sudden movement up or down, according as the rate of growth is enhanced or depressed by the action of an external agent.

In order to study the effects of external agencies on physiological excitability, it is first necessary to obtain a series of normal responses under stimuli of uniform intensity and duration, applied at regular predetermined intervals. This is accomplished by means of the automatic stimulator, in which an expansible fan periodically closes the exciting circuit. The intervals between successive applications and the period of stimulation are, in this instrument, capable of adjustment at will.

In a complete curve of response of the sensitive leaf or leaflet of *Mimosa* or *Biophytum sensitivum*, we find (1) a short horizontal line representing the latent period, (2) an up-curve showing attainment of maximum reaction; followed by (3) a down-curve representing the recovery. The latent period in a vigorous *Mimosa* is about .24 second. The effect of fall of temperature or fatigue results in the prolongation of this latent period to .3 of a second in the former and .58 in the latter case. The maximum fall of the leaf was attained in 1.5 seconds. Complete recovery takes place in 6 minutes in summer and in 18 minutes in winter. In a leaflet of *Biophytum*, the maximum fall is attained in .5 of a second and full recovery is reached in 3 minutes. The excitatory fall of the leaf takes place when stimulus is applied at or near the responding point. Seen from different points of view, this reaction will appear as a diminution of turgor in the pulvinus, constituting a negative turgidity-variation, or a shortening or contraction of the more excitable lower half of the pulvinus. Electrically speaking, this reaction will have its concomitant in an electrical variation of galvanometric negativity. It is convenient to include all these excitatory symptoms together under the single term *negative response*. Here, however, we may describe a responsive change of precisely opposite character, which takes place under definite conditions. This *positive response* consists of an erectile movement of the leaf; a positive turgidity-variation, expansion, and an electrical change of galvanometric positivity. The occurrence of this positive response may be demonstrated, in *Mimosa*, by applying stimulus at a point distant from the responding organ. In a certain experiment, this positive or erectile response occurred .6 second after the application of a stimulus, and was followed, 2.8 seconds later, by the normal excitatory fall of the leaf. Here we have a response which is *diphasic*, positive followed by negative. When stimulus is moderate, and applied at a still greater distance, the response evoked is positive alone. These facts obtain universally, and from them we derive the following law of direct and indirect stimulation: *The effect at the responding-region of a strong stimulus transmitted to a short distance, or through a good conducting channel, is negative. The effect transmitted to a great distance, or through a semiconducting channel, is positive.*

Responsive movements, like those of the "sensitive" plants so-called, can be detected also in ordinary plants. It will be noticed, in *Mimosa*, that the responsive movement is made possible by the unequal excitability of the upper and lower halves of the pulvinus, the movement being determined by the greater shortening or contraction of the lower. If now we take a hollow tubular organ of some ordinary plant, say the peduncle of daffodil, it is clear that the protected inner side of the tube must be the more excitable. When this is cut into the form of a spiral strip, and excited by means of an electrical shock, we observe a responsive movement to take place by *curling*, due to the greater contraction of the inside of the strip. This mechanical response is at its maximum at that season which is optimum for the plant. When the plant is killed, its response disappears.

In *Mimosa*, under continuous stimulation, there is a fatigue-reversal, the responsive fall being converted into a movement of erection. The same thing happens in the response of ordinary plants, when the first contractile movement of the spiral, for instance, is reversed, under continuous stimulation, to an expansive uncurling.

An important series of observations is that on the modification of response by the tonic condition

of the tissue. When the condition is sub-tonic, response is by the abnormal positive, instead of the normal negative, reaction. A strong or long-continued application of stimulus, however, converts this abnormal positive into normal negative.

Another important phenomenon is that for which the name of *multiple response* has been suggested. When the stimulus is very strong, the response is often not single, but repeated, or multiple. Excess of stimulus is thus seen to remain latent in the tissue, for rhythmic expression later. This storage of energy from the environment may in some cases be so great as to cause the continuance of rhythmic activity, even in the absence of immediate stimulation. We thus obtain a natural transition into so-called spontaneous or autonomous movements.

The various peculiarities of the spontaneous movements exhibited by *Desmodium gyrans*, or the telegraph plant, may be studied in the automatic record taken by the optical lever. The rhythmic tissues of the plant are then found to have characteristics which correspond to those of similar tissues in the animal. Lowering of temperature enhances the amplitude and diminishes the frequency of pulsation, in the rhythmic cardiac tissue of the animal. The same is found to be true of the pulsatory activity of *Desmodium gyrans*. The effects of various drugs are also very similar. The first result of the application of an anæsthetic like ether is to evoke a transient exaltation, followed by depression and arrest. Poisonous gases also induce a continuous depression of activity. A strong poisonous solution, again, induces a rapid arrest of pulsation.

It has thus been shown that by the waxing and waning of response, the variations in the plant's physiological activity, under changing external conditions, may be gauged. It has been shown also how numerous and varied are the factors that go to make up the complexity of plant-responses. It has been shown that stimulus may be modified in its effect, according as it is direct or indirect, and feeble, moderate or strong. The modifying influence of the tonic condition of the tissue has also been shown, according as this is normal, subtonic or fatigued. In the numberless permutations and combinations of these varied factors lies the infinite complexity of the responsive phenomena of life.

After a discussion of Professor Bose's paper by Doctors Rusby, Richards and Pond, the meeting of the club was adjourned to the second Tuesday in January.

Marshall A. Howe,
Secretary pro tem.

The Association of Ohio Teachers of Mathematics and Science

The association held its annual meeting in the Chemical Laboratory of the Ohio State University, December 29 and 30, 1908. The attendance of all meetings was very gratifying. The following program was carried out:

TUESDAY, DECEMBER 29, 1908, 1:30 P.M.

General Session

Business.

Mathematics Section

"The Mathematical Club in the High School; its Use as a Supplement to the Work of the Recitation," by J. C. Boldt, department of mathematics, East High School, Dayton.

"On the Nature of Mathematical Knowledge," by F. E. Miller, professor of mathematics, Otterbein University.

Round table.

Science Section

"Physics as a Factor in Forming Character," by C. M. Brunson, department of physics, Central High School, Toledo.

"The Narrow Path or the Broad?" by H. E. Newman, department of chemistry, Walnut Hills High School, Cincinnati.

Round table.

WEDNESDAY, DECEMBER 30, 9:00 A.M.

General Session

Business.

"The Purification of Drinking Water," by C. W. Foulk, department of chemistry, Ohio State University.

Mathematics Section

"Should Mathematics be Taught as a Basal Science or a Tool of Science?" by Paul Bieford, professor of mathematics and astronomy, Buchtel College, Akron.

"Should the Seventh to Tenth Grades be a Unit in Mathematics?" by R. L. Short, department of mathematics, Technical High School, Cleveland.

Round table.

Science Section

"An Apparatus for Demonstrating Wave Motion," by Fred J. Hillig, professor of physics, St. John's College, Toledo.

Experiments and demonstrations.

Round table.

WEDNESDAY, DECEMBER 30, 1:30 P.M.

Excursion to filtration plant now operated by the city of Columbus.

Ralph W. Buck,
Secretary

Dayton, Ohio